ATTACHMENT, AFFECT AND SOCIAL PROCESSING IN EATING DISORDERS

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ATTACHMENT, AFFECT AND SOCIAL PROCESSING IN EATING DISORDERS

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Abstract

Difficulties in social and emotional processing appear to play a role in the psychopathology of eating disorders (ED). Theoretical models describe how problems in social and emotional processing are related to the development and maintenance of the illness. The findings from previous systematic reviews and meta-analyses show that individuals with ED have difficulties in multiple aspects of social and emotional processing. A comprehensive review of social processing in ED presented in this thesis lends further support for the presence of difficulties with social and emotional processing in suffers with ED. However, much of the data in this area were gathered from self-report, which is subject to bias. The aim of this thesis was to examine the relationship between ED status and several aspects of social and emotional processing and to consider these findings in relation to the Cognitive Interpersonal Maintenance Model of the illness (C-IMM; Schmidt & Treasure, 2006). Four empirical studies focused on measuring several aspects of social and emotional processing in women with ED using both experimental and behavioural measures. The first study examined the role of implicit negative self-concept in women with Anorexia Nervosa (AN) compared to healthy women. The second study investigated attentional response, identification of others' emotion, subjective emotional response and facial expression towards the emotional displays of happiness, sadness and frustration in women with ED compared to healthy women. The third study examined maternal sensitivity to infant cues of happiness, sadness and frustration in women with ED compared to women without ED during late pregnancy. Finally, the fourth study examined newborn behaviour and mother-to-infant bonding during postpartum in women with ED compared to women without ED who were part of the same cohort of participants as in the third study. Overall the findings suggest that ED status is linked with specific rather than general anomalies in social and emotional processing. Women with ED had less facial expressivity towards displays of happiness in adults and infants. Women with ED underestimated happiness in infants. They experienced an amplified feeling of negative affect in response to infant sadness. Newborn infants of mothers with a current ED were more sensitive to environmental stress than newborns of mothers without ED. The strengths and limitations of these studies were considered and directions for future work were proposed in the context of the C-IMM of ED (Schmidt & Treasure, 2006). The clinical implications of the thesis were discussed in relation to treatment for these anomalies in social and emotional processing.

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I would like to thank Professor Janet Treasure and Dr Nadia Micali for their support and guidance with this project over the past few years. I am grateful to them for their generosity and for the exciting opportunities I was able to be a part of. Their inspiration was a great source of motivation. Many thanks to my colleagues Dr Valentina Cardi, Dr Abigail Easter, Dr Emma Taborelli and Amanda Bye for their support during the course of this research, and for everything in between. I am grateful to those that I have worked alongside for their encouragement, Dr Elizabeth Goddard, Dr Suman Ambwani, Dr Pinar Caglar-Nazali, Dr Ertimiss Eshkevari, Dr Radha Kothari, Francesca Solmi and Rebecca Hibbs. I am thankful to Dr Sue Pawlby, Enrica Fantini, Gill Todd and Dr Pamela MacDonald for their clinical insight. I am enormously grateful to all of those who helped me to recruit for the studies, Jenni Leppanen, Stephanie Deriziotis, Charlotte Rhind and Dr Alexandra Hadjimichalis. I would like to thank all of the people who agreed to participate in the project, including those newborn infants, without whose contribution these studies would not have been possible.

Overview of thesis and statement of candidate's contribution to studies

An outline of each chapter is provided below and overviews of empirical studies are accompanied by a statement of the candidate's contribution to the study.

Chapter 1

This chapter provided the contextual background to the thesis. It included an overview of the diagnostic and the clinical characteristics of ED. This was followed by a description of a maintenance model of the illness, which focused on the role of difficulties with social emotional processing and the psychopathology of ED. Literature related to the perinatal period was discussed with a focus on the role of maternal ED on newborn emotional development.

Chapter 2

This chapter stated the general aims of the thesis and specified the aims of each separate empirical study.

Chapter 3

The purpose of Chapter 3 was to synthesise the literature on social processing in ED, in order to provide a context to subsequent studies. This chapter presented the findings from a systematic review and meta-analysis of social processing according to the National Institute of Mental Health's (NIMH) Research and Domain Criteria (RDoC) project.

This study was supervised by Prof Janet Treasure and Dr Nadia Micali. A team of investigators, including myself, were responsible for conducting the literature search and article coding. Dr Pinar Caglar-Nazali, Dr Valentina Cardi, Dr Suman Ambwani, Jenni Leppanen, Olaolu Olabintan, Stephanie Deriziotis, Alexandra Hadjimichalis, Dr Pasquale Scognamiglio and Dr Ertimiss Eshkevari, were paired and were assigned a construct/sub-construct to study. Jenni Leppanen and myself produced the systematic review table. I was responsible for conducting meta-analyses, which were produced under consultation with Dr Mizandur Khondoker, a statistician at King's College London, Institute of Psychiatry.

Chapter 4

The purpose of Chapter 4 was to examine implicit self-criticism and attitudes towards self-descriptors in AN. This study was supervised by Prof Janet Treasure and Dr Nadia Micali. I was responsible for setting up the study, recruitment of the sample, data scoring, analyses and interpretation of findings. Parts of the data were collected by Dr Suman Ambwani, Amanda Li and Dr

Valentina Cardi. Miss Charlotte Krahé provided guidance on the data scoring and interpretation of the LDT. Dr Andy Perkins assisted in providing guidance on the data scoring of the self-criticism task.

Chapter 5

This chapter described a study which investigated the emotional reactivity to faces displaying basic positive and negative emotions in ED compared to HC.

These investigations were supervised by Prof Janet Treasure and Dr Nadia Micali. The candidate was responsible for carrying out the recruitment of the sample, data scoring, analyses and interpretation of findings for these studies. Dr Valentina Cardi assisted with aspects of the design and protocol of the studies. Parts of the data were collected and scored by Jenni Leppanen, Stephanie Deriziotis, Charlotte Rhind and Dr Alexandra Hadjimichalis. Dr Kate Tchanturia and Dr Helen Davies provided guidance on the film task protocol.

Chapter 6

This chapter described the general methodology for the following two chapters.

Chapter 7 and 8

Chapter 7 and 8 described two investigations based on the sample of participants recruited for the Nutrition and Stress in Pregnancy Project (NEST-p). The studies presented in these chapters investigated the impact of maternal ED on maternal sensitivity, offspring social emotional development and mother-infant bonding.

Prof Janet Treasure and Dr Nadia Micali supervised these projects. Dr Abigail Easter had set up the project and she as well as Dr Emma Taborelli and Amanda Bye were involved in the data collection and scoring of the measures. I was responsible for the testing, scoring, analysis and interpretation of the film task and Brazelton Neonatal Behavioural Assessment Scale (BNBAS). Dr Joanna Hawthorne, Dr Sue Pawlby and Enrica Fantini supported the candidate in training of the BNBAS.

Chapter 9

This chapter provided a summary of the main findings of the studies presented in the thesis. The results were integrated into the C-IMM of ED (Schmidt & Treasure, 2006). The main strengths and limitations of the thesis were summarised and areas for future research were highlighted. The clinical implications of the findings in the thesis were considered.

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Abbreviations

AAI	Adult Attachment Interview
AAS	Adult Attachment Scale
ABMT	Attentional Bias Modification Training
AET	Automatic Evaluation Task
AHQ	Attachment History Questionnaire
AN	Anorexia Nervosa
AN-B/P	Anorexia Nervosa Binge/Purging Subtype
ANOVA	Analysis of Variance
AN-R	Anorexia Nervosa Restricting Subtype
AN-Rec	Anorexia Nervosa Recovered
ANS	Automatic Nervous System
ASC	Autistic Spectrum Condition
BDI	Beck Depression Inventory
B-eat	Beating Eating Disorders
BED	Binge Eating Disorder
BIS/BAS	Behavioural Inhibition Scale/Behavioural Activation Scale
BMI	Body Mass Index
BN	Bulimia Nervosa
BNBAS	Brazelton Neonatal Behavioural Assessment Scale
BN-NP	Bulimia Nervosa Non-Purging Subtype
BN-P	Bulimia Nervosa Purging Subtype
BPD	Borderline Personality Disorder
BVAQ	Bermond Vast Alexithymia Quetsionnaire
CaMir	CaMir Q Sort
CBT	Cognitive Behavioural Therapy
CECAQ2	Childhood Experience of Care and Abuse
CFT	Compassion Focused Therapy
CI	Confidence Interval
CNS	Central Nervous System
CNV	Copy Number Variant
CRH	Corticotrophin Releasing Hormone
DAPP	Dimensional Assessment of Personality
DASS	Depression Anxiety Stress Scale
DSM	Diagnostic and Statistical Manual for Mental Disorders
EA	Experiential Avoidance
EABT	Emotional Acceptance Behavior Therapy
EAS	Emotional Assessment Scale
ED	Eating Disorder
EDDS	Eating Disorders Diagnostic Scale
EDEQ	Eating Disorder Examination Questionnaire
EDNOS	Eating Disorder Not Otherwise Specified
EFT	Emotion Focused Family Therapy
ERE	Emotion Recognition Experiment
ES	Effect Size
ESS	Experience of Shame Scale
FACES	Facial Expression Coding System
FEEL	Facially Expressed Emotion Labelling
FRTEE	Facial Recognition Take for Expressed Emotions

FSCS	Frankfurt Self Concept Scale
GAD	Generalised Anxiety Disorder
GWAS	Genome Wide Association Study
GxE	Gene Environment Interaction
HC	Healthy Control
HFA	High Functioning Autism
HPA	Hypothalamic Pituitary Adrenal
IAT	Implicit Association Task
ICD	International Classification for Diseases
IIP	Inventory of Interpersonal Problems
IPT	Interpersonal Perception Task
IQR	Inter Quartile Range
IRAP	Implicit Relational Assessment Procedure
ISS	Internal Shame Scale
KC	Kangeroo Care
KCH	King's College Hospital
KCL	King's College London
LDT	Lexical Decision Task
MDSEI	Multidimensional Self Esteem Inventory
MIB	Mother to Infant Bonding
MNS	Mirror Neuron System
ms	Milli Second
NESTp	Nutrition and Stress in Pregnancy
NICE	National Institute of Clinical Excellence
NIMH	National Institute of Mental Health
OCD	Obsessive Compulsive Disorder
OSS	Other as Shamer Scale
OSS	Olso Social Support Scale
PANAS	Positive and Negative Affective Scales
PBI	Parental Bonding Instrument
PD	Personality Disorder
RDoC	Research and Domain Criteria
RHIT	Rubber Hand Illusion
RME	Reading the Mind in the Eyes
RMF	Reading the Mind in the Films
RMV	Reading the Mind in the Voice
RSES	Rosenberg Self Esteem Scale
RT	Reaction Time
RTPJ	Right Temporopareital Junction
SBS	Submissive Behaviour Scale
SCID	Structured Clinical Interview for Diagnosis
SD	Standard Deviation
SE	Standard Error
SEI	Self Esteem Inventory
SEM	Standard Error of the Mean
SLaM	South London and Maudsley
SLCS	Self Liking Competence Scale
SNP	Single Nucleotide Polymorphism
SOA	Stimulus Onset Asynchrony
SPPA	Self Perception Profile for Adolescents

SPS	Sensory Processing Sensitivity
SRA	Self Rated Attractiveness
SSES	State Self Esteem Scale
STAI	State Trait Anxiety Inventory
SVT	Subjective Vertical Task
TAS	Toronto Alexithymia Scale
TET	Two Point Discrimination
TPD	Two Point Discrimination
TSCS	Tennessee Self Concept Scale
UCL	University College London
VEP	Visual Evoked Potential
YSQ	Young Schema Questionnaire

Thesis aims and objectives

The main aim of this thesis is to improve understanding of social emotional processing in eating disorders (ED). Data derived from experimental paradigms will be presented and considered within the context of the Cognitive Interpersonal Maintenance Model of ED (C-IMM; Schmidt & Treasure, 2006). Difficulties in social emotional processing have been described in explanatory models of ED.

Chapter 1

Introduction

1.1. Chapter aims

The first aim of this chapter is to provide an overview of the diagnostic and the clinical characteristics of ED. The second aim is to describe a maintenance model of the illness, which focuses on the role of difficulties with social emotional processing and the psychopathology of ED (beginning at point 1.8). The third objective is to discuss findings related to the perinatal period, with a focus on maternal-infant bonding and infant development of the offspring of mothers with ED (beginning at point 1.9). The hypotheses derived from the C-IMM of ED (Schmidt & Treasure, 2006) will be described.

1.2. Diagnostic classification

ED are complex and enduring psychiatric illnesses, which have a variety of effects on the health of the sufferer. Diagnosis is challenging as "diagnostic symptoms and associated behaviours substantially overlap across a range of eating disorders" (Treasure, Claudino, & Zucker, 2010) (p.1).

The Diagnostic and Statistical Manual for Mental Disorders (DSM) is one of the major diagnostic systems for mental disorders. The DSM is predominantly categorical and diagnostic criteria are used to define the presence or absence of a disorder (Pike, 2013). The DSM was in the process of being revised and the most recent edition, the DSM-5, was published in May 2013 (this was after data-collection had taken place for this thesis, and the previous version of the DSM, the DSM-IV, was utilised instead). The predecessor to the DSM-5, the DSM-IV, described three distinctive categories of ED: Anorexia Nervosa (AN), Bulimia Nervosa (BN) and Eating Disorder Not Otherwise Specified (EDNOS). A diagnosis of Binge Eating Disorder (BED) was described in the DSM-5. DSM-5 intended to improve classification of ED by refining the EDNOS category, which accounted for around 50-70% of individuals diagnosed with an ED (Ricca et al., 2001; Turner & Bryant-Waugh, 2004).

ED are described within Axis I of the DSM-IV. ED are characterised by extreme disturbances in eating behaviours and over-evaluation of body, weight and shape. ED can be differentiated from other psychiatric illnesses by the presence of denial of symptoms and reluctance to seek medical help despite the psychological and physical severity of the disorder.

1.2.1. Anorexia Nervosa

According to the DSM-IV TR (American Psychiatric Association, 2000) AN is characterised by the presence of: (a) a refusal to maintain body weight at or above a minimally normal weight for age and height (body weight less than 85% of that expected); (b) an intense fear of gaining weight, despite being underweight; (c) a disturbance in the way in which one's body weight or shape is experienced and a denial of the seriousness of underweight and undue influence of body weight and shape on self-evaluation; (d) relevant to postmenarchal females, the absence of three consecutive menstrual cycles.

Two distinct subtypes of AN are described: (a) a restricting type (AN-R) where the individual will attempt to restrict their food intake, but does not engage in binge/purging behaviour (e.g. vomiting, use of laxatives, diuretics or enemas) and a (b) a binge/purge type (AN-B/P) where the individual will engage in binge eating behaviours, consuming a greater amount of food than would usually be appropriate for his/her culture and experiences a loss of control while eating, which will be followed by purging behaviours (e.g. vomiting, use of laxatives, diuretics or enemas).

1.2.2. Bulimia Nervosa

Within the DSM-IV TR (American Psychiatric Association, 2000) the main features of BN are characterised by recurrent episodes of binge eating, consuming an amount that is larger than most people would eat under similar circumstances within a two hour period and recurrent inappropriate compensatory behaviours. Binge eating is accompanied by a loss of control of eating during the episode. Recurrent inappropriate compensatory behaviours for the purpose of preventing weight gain include self-induced vomiting, misuse of laxatives, diuretics, enemas or other medication, fasting and excessive exercise. The binge eating and inappropriate compensatory behaviours both occur twice per week for three months on average. Cognitions about self-evaluation are unduly influenced by body shape and weight. BN does not occur exclusively during episodes of AN.

There are two distinct subtypes of BN: (a) a purging type (BN-P) where the individual will engage in self-induced vomiting or the misuse of laxatives, diuretics or enemas and (b) a non-purging subtype (BN-NP) where the individual uses inappropriate compensatory behaviours, but will not regularly engage in purging (e.g. self-induced vomiting or the misuse of laxatives, diuretics or enemas).

1.2.3. Eating Disorder Not Otherwise Specified

EDNOS are outlined in the DSM-IV-TR (American Psychiatric Association, 2000) as disorders of eating that do not meet the criteria for any specific eating disorder. Examples of presentations which constitute as an EDNOS are: (a) a female who meets all of the criteria for AN, except has regular menses; (b) an individual who meets all of the criteria for AN, but has weight within the normal range; (c) an individual who meets all of the criteria for BN except that the binge eating and inappropriate compensatory behaviours occur at a frequency of less than twice a week or for a duration of less than three months; (d) an individual of normal body weight who employs inappropriate compensatory behaviour after eating small amounts of food; (e) an individual who chews and spits out, but does not swallow, large amounts of food.

1.3. Transdiagnostic approach

There is debate over whether ED should be considered as distinct within a spectrum of disorders or as different diagnosis across a continuum (Owen, Treasure, & Collier, 2001). The latter line of thought has been argued by proponents of the transdiagnostic approach. The authors argue that ED, which encompass AN, BN and EDNOS, should be recognised within a single category, along a continuum (Fairburn, Cooper, & Shafran, 2003). As it is widely accepted that there is substantial overlap between diagnostic criteria and a sufferer may meet the classification of more than one ED within their lifetime.

1.4. Diagnostic instability

Several studies report on the temporal movement between ED categories (e.g. Collings & King, 1994; Keel & Mitchell, 1997; Milos, Spindler, Schnyder, & Fairburn, 2005; Strober, Freeman, & Morrell, 1997). Thirty-seven per cent of individuals with a history of an ED were reported to satisfy the criteria for three of more ED subtypes during their lifetime (Anderluh, Tchanturia, Rabe-Hesketh, Collier, & Treasure, 2009). Transition from a diagnosis of AN to binge eating is commonly reported (Castellini et al., 2011; Eckert, Halmi, Marchi, Grove, & Crosby, 1995; Eddy et al., 2002; Monteleone, Di Genio, Monteleone, Di Filippo, & Maj, 2011). The effects of the recent changes to diagnostic classification in DSM-IV and DSM-5 has been summarised as: from AN to BN 27.3% and 23.4%; from BN to AN 9.2% and 8.4%; from BED to BN 8.8% and 7.1%; from BN to BED 10.9% and 8.4% (Castellini et al., 2011). Temporal movement between ED categories is commonly reported and recent changes to the DSM classification have implications for diagnostic crossover.

1.5. Assimilation with other disorders and psychiatric comorbidity

ED are often considered as part of and comorbid with other disorders. Hollander and colleagues (Bartz, Kaplan, & Hollander, 2007; Hollander, Friedberg, Wasserman, Yeh, & Iyengar, 2005; Hollander, Kim, Khanna, & Pallanti, 2007) propose that ED should be considered as part of the obsessive compulsive spectrum. The comorbidity between Obsessive Compulsive Disorder (OCD) and AN has been reported to be between 10-40% (Blachno & Brynska, 2012) and the link between OCD personality traits, such as perfectionism and rigidity, and AN has been described (Serpell, Livingstone, Neiderman, & Lask, 2002).

There has been suggestion that ED should be considered as part of the anxiety disorder spectrum (Waller, 2008) as the majority of people with ED will have more than one lifetime anxiety disorder (Godart et al., 2003; Kaye, Bulik, Thornton, Barbarich, & Masters, 2004; Kendler et al., 1995; Walters & Kendler, 1995). Rates of anxiety disorders appear to be similar across ED (Kaye et al., 2004) and ED are particularly comorbid with social phobia (Godart, Flament, Lecrubier, & Jeammet, 2000). The onset of anxiety disorders typically precedes the development of ED (Bulik, Sullivan, Fear, & Joyce, 1997; Deep, Nagy, Weltzin, Rao, & Kaye, 1995; Kaye et al., 2004).

It has been argued that there is a strong overlap between AN and autism spectrum conditions (ASC) (Gillberg & Råstam, 1993; Gillberg, 1983; Gillberg, Gillberg, Rastam, & Johansson, 1996; Rastam, Gillberg, & Wentz, 2003; Wentz et al., 2005). A recent systematic review reported that individuals with ED showed significantly higher rates of ASC, relative to healthy volunteers (Huke, Turk, Saeidi, Kent & Morgan, 2013). Difficulties with social cognition have been discussed between AN and ASC (Zucker et al., 2007). Individuals with AN and who met criteria for ASC showed the highest prevalence of Personality Disorders (PD) and poorer outcomes, compared to those with AN who did not meet criteria for ASC or healthy volunteers (Anckarsater et al., 2012).

Depression is highly comorbid with ED (Blinder, Cumella, & Sanathara, 2006; Garfinkel et al., 1995; Lewinsohn, Striegel-Moore, & Seeley, 2000; Zaider, Johnson, & Cockell, 2000) and has been shown to be the most prevalent comorbid disorder in one ED sample (Vardar & Erzengin, 2011). ED symptoms predict the onset of depression (Marmorstein, von Ranson, Iacono, & Malone, 2008; Stice, Burton, & Shaw, 2004) and it is believed that depressive symptoms, such as low self-esteem and helplessness, could trigger an ED (Casper, 1998). The course of major depressive disorder is protracted in ED (Mischoulon et al., 2011).

It has been argued that ED should be thought of as part of the obsessive compulsive, anxiety and autistic spectrum and as highly comorbid with depression. Also, ED appear to be comorbid with PD.

Compared to a non-clinical sample, people with ED had substantially more presentations of PD (Rosenvinge, Martinussen, & Ostensen, 2000).

1.6. Prevalence and epidemiology of eating disorders

The prevalence of ED varies between studies (Smink, van Hoeken, & Hoek, 2012). The lifetime prevalence of AN has been documented between 1.2% (Bulik et al., 2006) and 2.2% (Keski-Rahkonen et al., 2007) and the prevalence of BN between 1.7% (Keski-Rahkonen et al., 2009) and 2.9% (Wade, Bergin, Tiggemann, Bulik, & Fairburn, 2006). The lifetime prevalence of ED has been reported at: 0.3% for AN, 0.9% for BN and 1.6% for BED in a large representative sample of adolescents (Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). The lifetime prevalence of EDNOS has been reported at 4.78% (Le Grange, Swanson, Crow, & Merikangas, 2012).

ED typically develop during young adulthood. A recent study of primary care records over a ten year period (2000-2009) showed that in females the peak onset of AN and BN occurred between the ages of 10-14 and 15-19 respectively (Micali, Hagberg, Petersen, & Treasure, 2013). EDNOS was the most common incident diagnosed ED between the ages of 10-49. In males, the peak age of incidence of AN and BN occurred between the ages of 15-19 and 20-29 respectively. Incidence of EDNOS peaked earlier than in females, between the ages of 10-14. It has been reported that the age of onset of BED is 15 years (Kessler et al., 2013). ED are more typical in females than they are in males (Treasure et al., 2010). The DSM describes the ratio in females to males as 9:1 (American Psychiatric Association, 2000). People with ED have elevated mortality rates. Mortality rates are highest among those with AN and mortality rates are similar for those with BN and EDNOS (Arcelus, Mitchell, Wales, & Nielsen, 2011). The mortality rates of individuals with AN are the highest of all psychiatric conditions (Striegel-Moore & Bulik, 2007). Sullivan and colleagues (Swanson et al., 2011) reported that the fraction of deaths in the study population was 5.9%, the majority of deaths were due to ED complications or suicide. The reported prevalence of ED varies between studies and ED usually develop in young adulthood and are more common among females.

1.7. Aetiology of eating disorders

Several complex factors have been recognised in the aetiology of ED, which include genetic, biological, developmental and social influences (Collier & Treasure, 2004).

1.7.1. Genetic factors

Twin and family studies provide support for the role of genetic factors in ED (Zerwas & Bulik, 2011). ED are highly familial and heritability ranges between 50-83% (BED (Javaras et al., 2008) AN (Bulik, Slof-Op't Landt, van Furth, & Sullivan, 2007) BN (Bulik & Tozzi, 2004). Serotonergic, dopaminergic, opioid, appetite regulation and genes influencing food intake and weight regulation systems have all been under investigation, although conclusions cannot be drawn owing to small sample sizes and lack of replication (Trace, Baker, Penas-Lledo, & Bulik, 2013). A third of the genetic risk for ED is shared with depression (Wade, Bulik, Neale, & Kendler, 2000), anxiety (Keel, Klump, Miller, McGue, & Iacono, 2005) and addictive disorders (Baker, Mazzeo, & Kendler, 2007). To date, two genome-wide association studies (GWASs) have been conducted in ED. The results of the first GWAS detected that common single-nucleotide polymorphism (SNP), such as those within the OPRD1, and copy number variants (CNV) confer risk for AN (Wang et al., 2011). The findings from the second GWAS analysis of six ED related phenotypes noted an association of eight genetic variants (Boraska et al., 2012). Thus far, no GWAS has found genome-wide significant results in ED. Genetic factors appear to play a key role in the aetiology of ED although the highly variable ED phenotype poses a challenge for the study of candidate genes (Collier & Treasure, 2004).

1.7.2. Gene-environment interaction

Gene-environment interactions (GxE) could predispose to the development of ED and adverse experiences may trigger this interaction. It has been suggested that adverse experiences influence brain development and increase the risk for AN (Treasure et al., 2010). Particular parenting styles which are high in overprotection increase susceptibility to AN (Karwautz et al., 2010). Childhood adversity, including exposure to parental depression and substance and alcohol abuse, appears to increase the risk of developing BN (Fairburn, Welch, Doll, Davies, & O'Connor, 1997). Early adversity appears to increase the risk for developing an ED, although the mechanism is not entirely understood. Alterations to the neuroendocrine system could be a pathway by which early adversity confers risk for ED. Early adversity may alter the developing oxytocin system (Kumsta & Heinrichs, 2013). For example, people with AN have been shown to have lower levels of nocturnal serum oxytocin (Lawson et al., 2011) and cerebrospinal fluid levels of oxytocin are low during the starvation phase of AN (Chiodera et al., 1991; Demitrack et al., 1990). A review summarised the evidence for altered oxytocin functioning in AN (Maguire, O'Dell, Touyz, & Russell, 2013). Early adversity may underlie risk for ED, through changes to the oxytocin system.

1.7.3. Socio-cultural factors

There is increasing evidence to suggest that social factors play a role in the development of ED. According to the Tripartite Influence Model of body image and eating disturbance (Keery, Van den Berg, & Thompson, 2004), social-cultural factors such as peers, parents and media, influence body image and eating difficulties. The model suggests that social-cultural factors influence body image and eating difficulties through internalisation of the thin-ideal and appearance comparison processes. Pressure to be thin has also been recognised as socio-cultural risk factor (Stice, 2002). Meal times play a key role in interpersonal behaviour, unfavourable social comparisons fuel weight and shape concerns and the drive for thinness (Fairburn et al., 1998; Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004; Stice, Ng, & Shaw, 2010; Stice, 2002). Critical comments made by others, about weight and/or shape, have been linked with the development of BN (Fairburn et al., 1997; Karwautz et al., 2001). Also criticism, teasing and bullying which focus on food, weight and shape are associated with the risk for ED (Wade & Bulik, 2007). The neurodevelopmental model of AN (Connan, Campbell, Katzman, Lightman, & Treasure, 2003) focuses on the relationship between negative interpersonal experiences during adolescence and disordered eating. The model proposes that the adolescent period increases vulnerability to chronic stress which accompanies hypothalamic-pituitary-adrenal (HPA) axis dysregulation. It is suggested that stressful experiences, like negative interpersonal experiences, impair HPA axis response by elevating activity of the corticotrophin releasing hormone (CRH). As a result an imbalance between the anabolic and catabolic pathways of the hypothalamus could lead to a loss of appetite and weight. Negative interpersonal experiences could be linked with the development of ED. Genetic, epigenetic and social influences have been implicated in the development of ED.

1.8. Maintenance of eating disorders: Cognitive-Interpersonal Maintenance Model

It is widely recognised that there are a multitude of factors involved in the maintenance of ED. Social emotional processing has been identified as one of those factors. In the Cognitive-Interpersonal Maintenance Model of AN (Schmidt & Treasure, 2006), social and emotional factors are described to explain how ED are maintained. The model focuses on four particular intra- and interpersonal components. The model describes how these four factors result in symptom improvement. In the updated version of the model, Treasure and Schmidt (Treasure & Schmidt, 2013) describe that some of the social emotional traits present in patients are inherited vulnerabilities and are present in family members.

1.8.1. Cognitive factors

The model states that people with ED have a particular cognitive style, which is characterised by inflexible and detailed focused thinking. Recent neuropsychological findings show that people with AN have impairments in set-shifting ability (Kim, Kim, & Kim, 2010; Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007; Roberts, Tchanturia, & Treasure, 2010; Tchanturia, Davies, Roberts, et al., 2012; Tenconi et al., 2010), likened to cognitive rigidity, and they display weak central coherence (Lopez, Tchanturia, Stahl, & Treasure, 2008; Tenconi et al., 2010), characteristic of their attention to detail. Further support for this cognitive style shows that individuals with ED have difficulty in decision-making (Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007; Cavedini et al., 2004).

1.8.2. Social-emotional style

The model proposes that social emotional difficulties are present prior to the onset of the disorder. It is suggested that eating becomes threatening to the individual's emotional and physical equilibrium in the acute phase of the ED. They become disconnected from their emotions and show high levels of experiential avoidance and feel numb. Social emotional difficulties have been shown to be present prior to the onset of the disorder (Treasure, Corfield, & Cardi, 2012) and premorbid markers, such as loneliness, shyness, inferiority, have been documented (Fairburn et al., 1998; Fairburn, Cooper, Doll, & Welch, 1999). The effects of starvation on brain function could accentuate any underlying social emotional difficulties (McKnight & Boughton, 2009).

1.8.3. Pro-Anorexia Nervosa thinking

By excelling in attention to detail about dietary rules the individual develops positive beliefs about starvation. Pro-anorexia beliefs can include thoughts that the disorder helps the person keep control, feel better about their appearance, has advantages in terms of not having periods, communicates and regulates emotions and makes them feel special (Gale, Holliday, Troop, Serpell, & Treasure, 2006; Serpell, Teasdale, Troop, & Treasure, 2004). Positive beliefs about anorexia are related to a sense of control and a disconnection from emotions. The individual develops beliefs that the illness makes them feel attractive (Branch & Eurman, 1980) and special (Serpell, Treasure, Teasdale, & Sullivan, 1999) and they consider the illness to be a large part of their identity (Espindola & Blay, 2009).

1.8.4. Interpersonal factors

1.8.4.1. Social emotional problems in eating disorders

Problems with social emotional processing have been implicated in the development and maintenance of ED and have also been included in explanatory models of these illnesses (Treasure et al., 2012; Treasure & Schmidt, 2013). Several published reviews have documented that people with ED show difficulties with social emotional processing (e.g. Arcelus, Haslam, Farrow, & Meyer, 2013; DeJong et al., 2013; Nowakowski, McFarlane, & Cassin, 2013; Oldershaw et al., 2011; Rieger et al., 2010; Zucker et al., 2007), with particular focus on attachment (e.g. Ardovini, 2002; Astrachan-Fletcher, Veldhuis, Lively, Fowler, & Marcks, 2008; Kuipers & Bekker, 2012; O'Kearney, 1996; O'Shaughnessy & Dallos, 2009; Tasca, Ritchie, & Balfour, 2011; Ward, Ramsay, & Treasure, 2000; Zachrisson & Skarderud, 2010). These studies suggest that individuals with ED show impairments in interpersonal functioning. The degree to which individuals with ED show problems with social emotional processing will be the focus of a systematic review and meta-analysis in Chapter 3.

1.8.4.2. Response from others

The model states that dietary restriction is maintained intra-personally in the early stages of AN, through positive reinforcement from others for their efforts in eating restraint, which improves the sufferer's mood and wellbeing. Others subsequently become extremely concerned and worry about the declining physical appearance of the sufferer. This can result in increased care-giving behaviours from those around them. Consequently the ED may result in confrontation and hostility among close others. Particular response from close others, in the form of high expressed emotion (Goddard et al., 2011; Sepulveda, Kyriacou, & Treasure, 2009) and accommodation and enabling behaviours maintain the illness (Treasure et al., 2008). Both of these response styles have been observed in professional and family carers (Treasure, Crane, McKnight, Buchanan, & Wolfe, 2011). High expressed emotion and accommodating and enabling behaviours facilitate the illness, by reducing caregiving efficacy and by mirroring and escalating emotional arousal. There may be secondary effects of response from others. For example, the individual with AN may become intolerant of negative emotions and criticism and attempt to isolate themselves from others.

1.9. Psychological and physical problems across generations

At present the C-IMM does not address socio-emotional problems across generations, despite there being strong evidence to suggest that offspring of parents with a psychological disorder are at an

increased risk of disturbances in their development (Garmezy, 1996; Rutter & Quinton, 1984; Rutter, 1989). Children of mothers with ED appear to be at an increased risk of both physical and psychological problems (Park, Senior, & Stein, 2003). Alterations in offspring growth (Micali, Simonoff, & Treasure, 2009) and infant (Micali, Simonoff, & Treasure, 2011) and child feeding difficulties have been observed (Stein et al., 2006). Children of mothers with ED are more concerned with body shape and weight than those of mothers with no ED history (Patel, Wheatcroft, Park, & Stein, 2002). There has been comparatively less focus on social emotional development of the offspring of mothers with ED. The findings from recent studies show that the offspring of mothers with an ED have altered temperamental and emotional styles. Children of mothers with ED were rated as more 'fussy' and 'difficult' (Zerwas et al., 2012), higher in negative affect (e.g. sadness, crying, irritability) (Agras, Hammer, & McNicholas, 1999) and difficulties internalising and externalising compared to children of mothers without an ED in maternal reports (Cimino, Cerniglia, Paciello, & Sinesi, 2013). Also gender may differentially influence alterations in emotional development in children of mothers with an ED (Micali, Stahl, Treasure, & Simonoff, 2013). Children of mothers with ED show altered physical and psychological development. Emerging literature documents that the offspring of mothers with ED show difficulties in social emotional processing and attachment, which could be transmitted from parent to offspring.

1.10. Mother-infant relationship in the perinatal period

Maternal ED has been suggested to disrupt mother-infant bonding (Astrachan-Fletcher et al., 2008). Women with ED experience more difficulties in maternal adjustment in the early postnatal period (Koubaa, Hällström, & Hirschberg, 2008). There is evidence to suggest that difficulties with mother-infant bonding are present as early as in pregnancy (Foster, Slade, & Wilson, 1996; Lai, Tang, & Tse, 2006). Maternal ED is linked with difficulies in mother-infant bonding, although the relationship between mother and infant is better understood from the mother's perspective and there is no information available regarding the infant's contribution to this relationship.

1.11. Thesis aims within the Cognitive Interpersonal Maintenance Model

The aim of the present thesis is to gain more insight into the associations between ED and socio-emotional processing and response to affective cues. Five testable hypotheses were derived from previous literature described in each chapter that relate to the CIMM's area of *Interpersonal Factors* (Schmidt & Treasure, 2006). As described earlier, S*ocial Emotional Problems in ED* and *Response from Others* are considered to be included in the area of *Interpersonal Factors* within this model.

Each of the five proposed hypotheses will attempt to clarify specific aspects of *Interpersonal Factors* which might contribute to the maintenance of the illness, with a particular focus on self-concept, emotional response and the mother-infant dyad.

1. In the first study we aim to establish where the distinct strengths and weaknesses are in social processing in people with ED. Our first hypothesis is that people with ED will show difficulties with social processing across a range of constructs in this area.
2. In the second study we aim to investigate the relationship between AN and self-concept by examining implicit self-criticism and the processing of personally referent words. The second testable hypothesis is that individuals with AN will show a negative self-concept.
3. In the third study we aim to explore emotional response to basic positive and negative displays as expressed by adults and infants using behavioural tasks in women with ED compared to healthy women. The third testable hypothesis is that people with ED will show specific anomalies in response to positive and negative expressions, more so towards adult and infant cues.
4. In the fourth study, the aim will be to investigate maternal sensitivity towards the identification of infant cues. We will examine maternal sensitivity to infant displays of happiness, sadness and frustration in women with ED and no-ED during late pregnancy. The fourth testable hypothesis is that mothers with ED will show impairments in maternal sensitivity towards infant facial stimuli, rating them as less intense than healthy women.
5. In the fifth study we explore the associations between maternal ED status, newborn behaviour and mother-to-infant bonding (MIB). We explore newborn behaviour and maternal retrospective reports of MIB during this time. The fifth testable hypothesis will be that newborns of mothers with ED will have more behavioural difficulties, that mothers with ED will rate more problems with MIB.

Presented in the thesis are a series of experimental and behavioural studies that explore aspects of social-emotional processing involved in interpersonal interaction. There is scarcity of evidence from either experimental or behavioural measures to support this area of the model. The following chapter describes in further detail how the subsequent studies address these hypotheses.

1.12. Chapter summary

This chapter introduced the diagnostic and clinical characteristics of ED. The C-IMM of ED, which described how intra and interpersonal factors played a role in the maintenance of ED symptoms, was discussed. Five testable hypotheses from this model were identified.

Chapter 2

General Aims

2.1. Chapter aims

Five studies are presented in the following chapters. The aim of this chapter is to provide an overview of the general aims of each study.

2.2. Individual study aims

2.2.1. Chapter 3 aims

A systematic review and meta-analysis of the National Institute of Mental Health's Research and Domain Criteria Project 'Systems for Social Processes' in eating disorders

In order to test the first hypothesis, that people with ED will show difficulties with social emotional processing, this study will review the literature to date. The aim of the study presented in Chapter 3 is to synthesise the literature according to the National Institute of Mental Health's (NIMH) Research and Domain Criteria project's (RDoC) 'Systems for Social Processes' by using a systematic review and a meta-analysis.

2.2.2. Chapter 4 aims

Self-concept in Anorexia Nervosa

The study presented in Chapter 4 will test the second hypothesis, that individuals with ED will show a negative self-concept. We aim to examine implicit self-criticism and the processing of negative self-descriptors using experimental tasks in women with AN compared to HC, taking into account perceived social support and behavioural inhibition as potential correlates.

2.2.3. Chapter 5 aims

Social-emotional processing in Eating Disorders.

Chapter 5 will aim to address the third testable hypothesis, that people with ED will show social emotional anomalies in response to adult and infant facial stimuli. We aim to investigate socio-

emotional response to basic emotions displayed by adults and infants in pictures and film clips in women with ED compared to HC using behavioural tasks. More specifically we aim to examine whether social support and behavioural tendencies are correlates of attentional processing and facial expression.

2.2.4. Chapter 6 aims

General methodology

The aim of Chapter 6 is to describe a general methodology for the subsequent studies presented in Chapters 7 and 8.

2.2.5. Chapter 7 aims

Identification of infant's emotion in women with eating disorders during late pregnancy: A preliminary study

Chapter 7 will address the fourth testable hypothesis, that mothers with ED will have impairments in maternal sensitivity towards infant facial stimuli. We aim to investigate the perception of the emotional intensity of infant displays during late pregnancy in women with ED compared to HC. A further aim of the study is to examine whether specific maternal psychopathology, i.e. ED symptoms, and maternal Body Mass Index (BMI) during pregnancy could predict perception of infant emotion.

2.2.6. Chapter 8 aims

Caregiver-interactive system in women with eating disorders: Newborn behaviour and mother infant-bonding

Chapter 8 will test that difficulties in the mother-infant dyad, specifically related to mother-to-infant bonding and newborn communication, will be found in mothers with an active ED. The aim of this study is to investigate whether maternal prenatal ED is linked with both poorer behavioural and social aspects of newborn functioning and with less than optimal mother-newborn bonding. Another aim of the study was to investigate the relationship between maternal psychopathology and newborn behaviour.

Chapter 3

A systematic review and meta-analysis of the National Institute of Mental Health's Research and Domain Criteria Project 'Systems for Social Processes' in eating disorders.

3.1. Approach to diagnosis

There is concern that using diagnostic systems which are based on diagnostic boundaries, as in the case of the DSM and the International Classification for Diseases (ICD), may not accurately conceptualise the underlying pathophysiological mechanisms of impairment. Both the DSM and the ICD use a categorical approach to diagnosis, which are based on signs and symptoms of illness. This difficulty may reduce the speed at which new treatments are developed to target underlying dysfunction (Insel et al., 2010).

3.2. Research and Domain Criteria Project: An alternative approach

The NIMH RDoC was developed as an alternative method to classify psychological disorders using the dimensions of observable behaviours and brain functions (http://www.nimh.nih.gov/research-priorities/rdoc/nimh-research-domain-criteria-rdoc.shtml). The main objective for the RDoC is to make "*advances in genomics, pathophysiology, and behavioral science to inform diagnosis in a meaningful way*". In its current form the RDoC provides a framework of genomics, neuroscience and behavioural science which guides the classification of patients for research with the intention of developing a research foundation to inform diagnosis and interventions. The RDoC presents a matrix, where the rows in the matrix illustrate the functional construct of interest. These are categorised into superordinate domains. The columns represent units of analysis (e.g. genes, molecules, cells, circuits, behaviour and self-reports). Therefore a multi-systems approach is used as a guide to characterise the psychopathology of mental illness (Cuthbert & Insel, 2013). Psychopathology is described according to impairment of type and degree in a particular system. The purpose of the RDoC is to be able to specify the neural systems that sub-serve primary behavioral functions that the brain has evolved to perform (Morris, Rumsey, & Cuthbert, 2013). Thus a synthesis of the literature according to the domains within the RDoC framework could offer an insight into the underlying psychopathology.

3.3. Social processing and the psychopathology of eating disorders

As described in Chapter 1, difficulties with social and emotional functioning have been implicated in the development and maintenance of ED. These problems have thus been included in explanatory models of these illnesses (Schmidt & Treasure, 2006; Treasure et al., 2012; Treasure & Schmidt, 2013). Difficulties in social and emotional processing have been the subject of several published reviews (e.g. Arcelus et al., 2013; DeJong et al., 2013; Nowakowski et al., 2013; Oldershaw et al., 2011; Regier, Narrow, Kuhl, & Kupfer, 2009; Zucker et al., 2007). The majority of these have focused on attachment (e.g. Ardovini, 2002; Astrachan-Fletcher et al., 2008; Kuipers & Bekker, 2012; O'Kearney, 1996; O'Shaughnessy & Dallos, 2009; Tasca et al., 2011; Tetley, Moghaddam, Dawson, & Rennoldson, 2013; Ward et al., 2000; Zachrisson & Skarderud, 2010). These reviews suggest that individuals with ED show dysfunctions in social and emotional processing. At present, the RDoC outlines 'Systems for Social Processes' as one of the five domains of functioning within the framework. Table 1 presents the four constructs and nine subconstructs and their definitions. 'Social Dominance' is a fifth construct, but at present is not defined.

3.4. Study aim

The aim of the study presented in this chapter will be to conduct a systematic review and meta-analysis of the literature related to the psychopathology of ED based on the RDoC domain of 'Systems for Social Processes'. It is important to state here that the RDoC is under refinement and therefore the definitions of constructs/sub-constructs are relatively fluid. Domains which were considered to represent social processes in mental health research were not all easy to define in ED. We had several consensus meetings to operationalise domains which were particularly difficult to define.

3.5. Methodology

3.5.1. Literature search

A search using the electronic databases Embase (1974-present), Medline® (1946-present), PsycINFO (1806-present) using Ovid and Science Citation Index Expanded (1900-present), Social Sciences Citation Index (1956-present) and Arts & Humanities Citation Index (1975-present) using Web of Science® to identify relevant articles written in English in peer reviewed journals during available years of publication to March 2013 (week 4) following the PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2010) was undertaken. The keywords used in the search were: EATING DISORDER* or ANOREX* or BULIMI* or BINGE EATING DISORDER* which were combined with search

terms outlined in the 'Systems for Social Processes' presented in Table 1. The limiter 'not COLLEGE STUDENT*' reduced the amount of non-clinical studies returned (* indicates truncation).

The majority of the keywords were obtained from the RDoC matrix, which provided a description of the construct/subconstruct. Additional keywords not mentioned in the RDoC matrix were obtained from published reviews (e.g. Arcelus et al., 2013; DeJong et al., 2013; Nowakowski et al., 2013; Oldershaw et al., 2011; Regier, Narrow, Kuhl, & Kupfer, 2009; Zucker et al., 2007). The candidate and her fellow researchers met to discuss the choice of terms to use and they agreed on the finalised keywords based on the above approaches.

We decided to include only clinical cases who were seeking treatment. Subclinical cases recruited from the community were not included as in RDoC research it is important to describe the frame from which cases are taken rather than diagnosis itself. This choice reduced the reliance on using diagnostic boundaries, as mentioned previously using diagnostic boundaries can be problematic. It was difficult to impose this criterion for subclinical cases when the data were collected retrospectively. Data from clinics were included to provide coherence to the sample frame, as many cases in clinics would be college students.

Table 1. Outline of 'Systems for Social Processing' constructs and the search terms.

Construct	Sub-Construct	Search Terms (* indicates truncation)
(1)Affiliation & Attachment	Attachment formation and maintenance	ATTACHMENT or PARENTAL BONDING or AFFILIATION or SOCIAL ANHEDONIA
(2) Social Communication	(2a) Reception of Facial Communication	EYE GAZE or SCANNING PATTERN* or IMPLICIT MIMICRY or AROUSAL RATING* or EMOTION* FACE EXPRESS* or FAC* FEATURE MANIPULAT* or STILL FACE or DISTRESS PARADIGM or SOCIAL REWARD or EMOTIONAL STROOP or EMOTIONAL GO or DYNAMIC SOCIAL STIMUL* or JOINT ATTENT* or FACE PRIM* or CHIMERIC or MASK* or IMPLICIT SOCIAL PERCEPT*
	(2b) Production of Facial Communication	EYE GAZE or HEAD TURN* or RECIPROCA* EMOTION* EXPRESS* or FACIAL AFFECT PRODUCTION or JOINT ATTENTION or IMITATION or BERKELEY EXPRESSIVITY or FACS CODING or FACES CODING or THIN SLICES OF NON-VERBAL BEHAVIO* or RE-LIVED MEMOR* or SOCIAL GAME* or ELICIT EXPRESSION* or STILL FACE or DISTRESS PARADIGM
	(2c) Reception of Non-Facial Communication	EMOTION* PROSOD* or IRON* or SARCAS* or COMPREHENSION or METAPHOR* or NON-VERBAL GESTURE* or HUMOR* or SOCIAL RESPONSIVE* SCALE* or LANGUAGE* or BIOLOGICAL MOTION DISCRIMINATION or OLFACTORY HEDONIC* or THIN SLICES OF NON-VERBAL BEHAVIO* or STILL FACE
	(2d) Production of Non-Facial Communication	CRY* or LAUGH* or VOCALI* or SPEECH or GESTURE* or POSTUR* or INTERACTIVE PLAY or COMPUTER INTERFACE or VOCAL PRODUCTION CODING SYSTEM* or COMPUTATIONAL LINGUISTIC* or STILL FACE
(3) Perception & Understanding of Self	(3a) Agency	SELF AGENCY or BODY REPRESENTATION or BODY PERCEPTION* or SELF RECOGNITION or BODILY SELF or BODY SIZE ESTIMATION or PROPRIOCEPT* or INTEROCEPT* or OWN BIOLOGICAL MOTION or FORD COROLLARY DISCHARGE or REALITY MONITOR* or MOTOR FEEDBACK or SENSORY FEEDBACK
	(3b) Self-Knowledge	LEVELS OF EMOTIONAL AWARENESS or ALEXITHYMIA or SELF-CONSCIOUS* or SELF-COMPONENT* OF ATTRIBUTION STYLE* or SELF-MONITOR* or SELF-JUDGEMENT* or SELF-REFERENCE EFFECT* or META-COGNITION* or DISCREPANCY IN SELF RATING* or DISCREPANCY IN PEER RATING* or SELF-ESTEEM
(4) Perception & Understanding of Others	(4a) Animacy Perception	ANIMACY or POINT LIGHT DISPLAY* or ATTRIBUTION OF CONTINGENT BEHAVIO*
	(4b) Action Perception	IMITATION or MIMICRY or GAZE FOLLOWING or EMOTIONAL EMPATHY SCALE* or PERSPECTIVE TAKING or EMPATHIC CONCERN or INTERPERSONAL REACTIVITY or EMPATHY QUOTIENT or ACTION OBSERVATION or SELF-OTHER MORPHS or NON-VERBAL DECODING or WHY/HOW TASK or EMPATHIC ACCURACY

Construct	Sub-Construct	Search Terms (* indicates truncation)
	(4c) Understanding Mental States	ATTRIBUTION STYLE* or BALANCED EMOTION* EMPATHY or PERSPECTIVE TAKING or EMPATHIC CONCERN or INTERPERSONAL REACTIVITY or EMPATHY QUOTIENT or STRANGE STORES or DIRECTORS TASK or FAUX PAS or READING THE MIND IN THE EYES or WHY TASK or DUNBAR INTENTIONALITY or IRONY COMPREHENSION or EMPATHIC ACCURACY
(5) Social Dominance	(5) Social Dominance	DOMINAN* or SUBMISSI* or SOCIAL RANK* or SOCIAL POWER or SOCIAL HIERARCH* or SHAME* or SOCIAL STATUS*

3.5.2. Eligibility criteria

Studies were required to meet the following five criteria: (a) investigate a construct/sub-construct within the NIMH RDoC 'Systems for Social Processes' domain which are: 'Affiliation and attachment', 'Reception of Facial Communication', 'Production of Facial Communication', 'Reception of Non-Facial Communication', 'Production of Non-Facial Communication', 'Agency' 'Self-Evaluation', 'Animacy Perception', 'Action Perception', 'Understanding Mental States' and 'Social Dominance'; (b) include a clinical sample of people with ED (AN; BN; EDNOS and/or BED) who were diagnosed with a clinical instrument. ED participants with comorbidity were included; (c) include a HC comparison group who never suffered from an ED or any other psychiatric disorder; (d) report standard quantitative information (mean, standard deviation (SD), sample size for ED and HC groups) based on self-report or behavioural instruments related to the construct/subconstruct of investigation; and (e) have a minimum of fifteen participants per comparison group.

3.5.3. Study selection

The candidate and her colleagues (P.C., F.C., V.C., S.A., J.L., O.O., S.D., A.H., P.S., E.E.) were paired and then assigned responsibility for performing literature searches for the NIMH RDoC subdomains. The pair of authors conducted final screening and assessment for eligibility. When there was uncertainty, criteria compliance was agreed by with referral to the whole team (see Table 2 for study selection from identification to inclusion). The bibliographies from all the relevant reviews were inspected for additional studies which were not yielded by the initial literature search. Relevant studies either in preparation or those at the submission stage which were authored by our research group were inspected. The corresponding authors were contacted to obtain the required data which were not reported in the article. Some studies were included more than once in the synthesis of the literature as their test battery spanned more than one construct/subconstruct.

Table 2. Study selection for meta-analysis of social processing in eating disorders

Study Selection for Systems for Social Processes (n)				
	Identification	Excluded based on abstract	Full-text articles screened	Inclusion
(1) Affiliation & Attachment	411	248	163	36
(2) Social Communication				
(2a) Reception of Facial Communication	133	100	33	13
(2b) Production of Facial Communication	30	28	3	3
(2c) Reception of Non-Facial Communication	473	452	23	3
(2d) Production of Non-Facial Communication	185	165	16	3
(3) Perception & Understanding of Self				
(3a) Agency	604	598	14	8
(3b) Self-Knowledge	805	648	157	71
(4) Perception & Understanding of Others				
(4a) Animacy Perception	1	0	1	0
(4b) Action Perception	59	50	9	0
(4c) Understanding Mental States	59	41	18	20
(5) Social Dominance	318	248	70	9

3.5.4. Data collection

Empirical data, which corresponded to each construct/subconstruct, were operationalised according to the construct/subconstruct descriptors (provided on the NIMH website: http://www.nimh.nih.gov/research-priorities/rdoc/rdoc-constructs.shtml#attachment_formation). Articles which measured environmental aspects of early childhood experience were excluded from 'Affiliation and Attachment', as Tetley et al. (Tetley et al., 2013) have recently published a systematic review of these. The mean, SD and sample size were obtained from self-report and behavioural measures for HC and ED, by diagnosis and clinical status (e.g. recovered) if available. Both significant and non-significant data were included. Eight corresponding authors (Cardi, Matteo, Corfield, & Treasure, 2012; Cserjesi, Vermeulen, Lenard, & Luminet, 2011; Eshkevari, Rieger, Longo, Haggard, & Treasure, 2012; Harrison, Sullivan, Tchanturia, & Treasure, 2010; Harrison, Tchanturia, & Treasure, 2010; Harrison, Sullivan, Tchanturia, & Treasure, 2009; Rozenstein, Latzer, Stein, & Eviatar, 2011; Striegel-Moore et al., 2005; Vandereycken & Perris, 1994) were contacted to provide relevant data from their published articles. Data from one article in this lab was extracted (Rhind et al., submitted) as it contained a sample of adolescents with AN. The other study within this subconstruct (Davies et al., 2011) contained a sample of adults with AN. Therefore including the unpublished study (Rhind et al., submitted) allows for the comparison of production of facial expression across patient ages. From personal communication with Oldershaw et al. (Oldershaw et al., 2011), the standard error (SE) scores for the emotion recognition task reported by Mendlewicz and colleagues (Mendlewicz, Linkowski, Bazelmans, & Philippot, 2005) were transferred into SD. For other studies where the SE was reported, the SD was calculated from the SE using the formula $\bar{\square} = \frac{\square}{\sqrt{\square}}$. The paper by Bydlowski (Bydlowski et al., 2005) was excluded due to inconsistencies between written text and data reported in the article (the mean scores reported in Table 1 are higher in the control group than in the patient group; however the corresponding text description states that the patient group had more alexithymia (i.e. higher scores) than controls). In the case that a paper included the same sample of participants, the first published article of the series was retained.

3.5.5. Data synthesis

The data were synthesised by combining scores from subtypes of ED (e.g. restrictive and purging types). Also by deriving a global score from subscale scores where appropriate, when a total score was not reported. For two studies (Kucharska-Pietura, Nikolaou, Masiak, & Treasure, 2004; Legenbauer, Vocks, & Ruddel, 2008) a weighted mean was calculated due to an imbalance in the number of positive and negative stimuli displayed in the task. Four is the minimum number of

studies to be included in a meta-analysis (Rosenthal, 1991), which is why meta-analyses were only possible for the constructs/subconstructs of: 'Affiliation and attachment', 'Reception of Facial Communication', 'Production of Facial Communication', 'Agency', Self-Evaluation', 'Understanding Mental States' and 'Social Dominance'. Meta-analysis was not permitted on the constructs/subconstructs of 'Reception of Non-Facial Communication', 'Production of Non-Facial Communication', 'Animacy' and 'Action' which contained fewer than four studies. When a meta-analysis was possible, two steps were taken to avoid mixing *apples* and *oranges*: (a) self-report and experimental data were not combined in a single meta-analysis, the most prevalent type of methodology (either self-report or experimental) used to measure the construct/subconstruct was retained for analysis; (b) papers where the direction of the scoring system (i.e. higher score indicated worse functioning and vice versa) was different from the majority of the papers, were not retained for the analysis. For articles which did not meet the criteria set out for the meta-analysis in step (a) and (b) were discussed under 'Systematic Review' headings in the Results section.

3.5.6. Statistical analyses

The meta-analyses were performed using Stata 11.0 (Stata Corporation, College Station, TX, USA). The user-contributed commands metan (Bradburn, 1998), metanbias, metantrim (Steichen, 1998) and metareg (Sharp, 1998) were used. Cohen's d, which is the difference between the two raw means of the ED and HC group divided by the pooled standard deviation, and the 95% confidence intervals (CI) are reported for each analysis. Cohen's d ES (ES) can be interpreted according to the following parametres: negligible (≥-0.15 and >0.15); small (≥0.15 and >0.40); medium (≥0.40 and >0.75); large (≥0.75 and >1.10); very large (≥1.10 and >1.45) and huge (≥1.45). Based on the direction of coding in the meta-analysis, a positive Cohen's d ES can be interpreted as meaning that the ED group had difficulties in that aspect of social processing. CI's falling on either side of zero represent non-significant effects. The meta-analysis including ED subgroups versus HC using the pooled standard ES between groups was conducted using the random-effects model which assumes that both the within-group variability of scores and mean ES are caused by differences between the studies. The I^2 index (0-1) was used to measure the magnitude of heterogeneity and Cochran's Q statistic was used to formally test the assumption of homogeneity of true ES (Higgins, Thompson, Deeks, & Altman, 2003). To adjust for variation in measurement and group type meta-regressions were performed. Meta-regressions functioned to examine the impact of moderator variables (e.g. measurement and group type) on the study ES. Publication bias was assessed using Begg's adjusted rank test (Begg & Mazumdar, 1994), Egger's test (Egger, Smith, Schneider, & Minder, 1997) and the

trim and fill method (Duval & Tweedie, 2000), since there is a greater likelihood that statistically significant results will be published. The trim and fill method gives rise to an adjusted ES through a simple rank based augmentation technique, which estimates and adjusts for the number and outcome of missing studies (i.e. studies that have not been published; Duval & Tweedie, 2000).

3.6. Results

3.6.1. Characteristics of included studies

Presented in Table 3 is the summary of the main characteristics of each study included in the systematic review and meta-analyses. The *next to the authors name denotes studies that were included in the meta-analysis. The subscript [a] next to the authors name signifies that studies contained the same HC comparison group. The column headed 'Outcome of Measure' gives a description of the comparison of the ES between clinical group and control group. The column titled 'Group and N' shows which patient group (e.g. AN, BN, ED) is being compared to the control group. For example the study by Chassler (1997) compares attachment between ED and controls. The table does not give a comparison between two clinical groups.

Self-report instruments were used mainly to assess the areas of 'Affiliation and attachment', Self-Evaluation' and 'Social Dominance', while experimental tasks were primarily used to test the areas of 'Reception of Facial Communication', 'Production of Facial Communication', 'Reception of Non-Facial Communication', 'Agency' and 'Understanding Mental States'. Only in the area of 'Production of Non-Facial Communication', was there the same number of self-report and experimental tasks. The majority of studies investigated a sample of individuals with a current diagnosis of AN.

Table 3. Study characteristics of studies included in the review of social processing in eating disorders

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
'Affiliation and Attachment'							
*Amianto et al. (2011)	AN 38	26.31 (7.4)	16.42 (2.0)	NR	Attachment Style Questionnaire Parental Bonding Instrument	Insecurity Lower security Lower Parental Care Higher Parental Overprotection	0.779 (0.335, 1.223) 0.981 (0.534, 1.427) 0.900 (0.457, 1.343) 1.229 (0.768, 1.689)
	HC 50	23.95 (2.1)	21.86 (2.7)	-			
*Bonne (2003)	BN 16	23 (2)	19.96	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.803 (0.081, 1.525) 0.254 (-0.441, 0.950)
	HC 16	23 (2)	19.96	-			
*Bulik et al. (2000)	AN 15 AN-Rec 21	23-45	18.5 (2.6)	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	1.123 (0.560, 1.686) 0.408 (-0.066, 0.883) 0.379 (-0.167, 0.925) 0.496 (0.020, 0.972)
	HC 98	23-45	25.6 (6.5)	-			
*Calam et al. (2006)	AN 31 BN 67	25	-	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.104 (-0.270, 0.478) 0.438 (0.166, 0.711) 0.266 (-0.108, 0.641) 0.190 (-0.081, 0.461)
	HC 242	22.9	-	-			
*Canetti et al. (2008)	AN 43	21.3 (3.7)	16.7 (2.1)	5 depressive disorder	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.711 (0.243, 1.179) 0.399 (-0.060, 0.857)
	HC 33	22.3 (4.5)	21.2 (2.3)	-			
*Cardi et al. (2012)	AN 29 BN 17 ED-Rec 22	27.3 (10.2)	19 (4.0)	AN and BN 43.5% comorbidity ED-Rec 27.3% comorbidity	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.750 (0.227, 1.222) 0.994 (0.418, 1.571) 0.527 (0.018, 1.036) 0.635 (0.166, 1.103) 0.662 (0.100, 1.224)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 50	25.3 (7.4)	21.7 (1.9)	-			0.651 (0.138, 1.164)
*Chassler (1997)	ED 26	30 (10.6)	NR	NR	Attachment History Questionnaire	Insecurity Lower security	0.832 (0.288, 1.376) 1.064 (0.506, 1.622)
	HC 31	37 (9.2)	NR	NR			
Cunha et al. (2009)	AN 34	17.26 (2.71)	NR	ANR 28 ANBP 6	Inventory of Parent and Peer Attachment	Lower general attachment	0.460 (0.029, 0.949)
	HC 34	17.18 (2.77)	NR	NR			
*Deas et al., (2011)	AN 40 HC 78	29 (10.31) 20 (5.05)	17.28 (3.02) 23.27 (4.03)	NR -	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.758 (0.364, 1.151) 0.523 (0.135, 0.910)
*De Panfilis et al. (2003)	ED 64	32.2(11.5)	AN 16.5 (1.6); BN 22.3 (5.6); BED 34.6 (6.2)	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.677 (0.326, 1.028) 0.306 (0.038, 0.649)
	HC 68	29.8 (8.9)	21.4 (1.3)	-			
*DePentima et al. (1998)	AN 69	14.85 (1.77)	15.72 (2.29)	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.589 (0.229, 0.949) 0.212 (-0.141, 0.566)
	HC 56	13.16 (0.5)	22.15 (3.05)	-			
Doba et al. (2008)	AN 14	19.23 (1.96)	13.9 (1.14)	-	Autobiographical narrative	Fewer semantic description of interpersonal relationships	0.071(0.684, 0.826)
	HC 13	20.5 (1.87)	NR	-			
*Fassino et al. (2010)	BN 154	32.71 (10.4)	22.69 (3.5)	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.946 (0.711, 1.812) 0.533 (0.305, 0.760)
	HC 154	24.36 (3.6)	20.04 (1.6)	-			
*Fujimori et al. (2011)	ED 80	25.6 (6.75)	-	-	Parental Bonding Instrument	Lower Parental Care Higher Parental	0.495 (0.208, 0.782) 0.222 (-0.061, 0.506)
	HC 120	-	-	-			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
						Overprotection	
*Gomez (1984)	BN 20	19-29 20-35	-	-	Parental Bonding Instrument	Lower Parental Care	0.930 (-0.276, 1.585)
	HC 30	20-50	-	-		Higher Parental Overprotection	0.654 (-0.017, 1.291)
*Guttman & Laporte (2002)	AN 51	22	-	NR	Parental Bonding Instrument	Lower Parental Care	0.227 (-0.795, 0.341)
	HC 50	21	-	-		Higher Parental Overprotection	0.389 (-0.183, 0.961)
*Holliday et al. (2006)	AN 138	AN-Cur 33.0 (12.1) AN-Rem 36.0 (12.3)	AN-Cur 16.3 (2.1) AN-Rem 20.8 (2.6)	AN-Cur 83 AN-Rem 55 ANBP 18 ANR 36	Dimensional Assessment of Personality Pathology	Insecurity	0.666 (0.417, 0.915)
	HC 124	36.0 (12.3)	20.8 (2.6)	-			
*Illing et al. (2010)	AN 120	ANR 24.71 (9.00) ANB 28.31 (10.27)	16.22 (0.58)	ANR 49 ANB 71	Attachment Style Questionnaire	Insecurity	1.049 (0.782, 1.315)
	BN 123	26.65 (7.76)	24.41 (5.92)	-		Insecurity	1.139 (0.871, 1.407)
	HC 126	23.23 (7.06)	23.01 (3.74)	-			
Kenny & Hart (1992)	ED 68	22.2 (4.17)	NR	BN 74% AN 13% AN/BN 13%	Parental Attachment Questionnaire	Lower general attachment	1.124 (0.822, 1.425)
	HC 162	18.47 (1.40)	NR	NR			
*Kent & Clopton (1992)	BN 26	<25	-	NR	Parental Bonding Instrument	Lower Parental Care	0.404 (-0.168, 0.975)
	HC 24	<25	-	-		Higher Parental Overprotection	0.285 (-0.284, 0.864)
*Laporte et al. (2007)	AN 34	23.5 (7)	-	NR	Parental Bonding Instrument	Lower Parental Care	0.241 (-0.722-0.240)
	HC 33	23.4 (7)	-	-			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
						Higher Parental Overprotection	0.409 (-0.075, 0.893)
*Leung et al. (2000)	AN 30 BN 27	24.35 (5.67) 25.6 (5.13)	16.5 (1.14) 21.0 (1.42)	NR	Parental Bonding Instrument	Lower Parental Care Lower Parental Overprotection Higher Parental Overprotection	1.000 (0.423, 1.577) 1.259 (0.648, 1.869) 0.612 (0.056, 1.168) 1.254 (0.644, 1.864)
	HC 23	26.4 (4.67)	21.6 (1.66)	-			
*Latzer et al. (2002)	AN 25	22.3 (6.8)	NR	-	Adult Attachment Scale	Lower security Insecurity	1.289 (0.731, 1.846) 0.991 (0.454, 1.529)
	BN 33	21.9 (3.7)	NR	-		Lower security Insecurity	1.078 (0.575, 1.581) 1.243 (0.730, 1.757)
	HC 37	21.9 (3.7)	NR	-			
*Miljkovitch et al. (2005)	ED 26	20.3 (2.95)	NR	-	CaMir Q	Lower security Dismissing/ Preoccupied	0.599 (0.037, 1.160) 0.622 (0.059, 1.184)
	HC 25	19.9 (2.71)	NR	-			
*Palmer et al. (1988)	AN 35 BN 37	24.3	-	NR	Parental Bonding Instrument	Lower Parental Care Lower Parental Overprotection Higher Parental Overprotection	0.267 (-0.078, 0.613) 0.626 (0.288, 0.965) 0.170 (-0.515, 1.176) 0.034 (0.303, 0.370)
	HC 410	-	-	-			
*Rhodes & Kroger (1992)	ED 20	19.2	-	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.618 (-0.017, 1.253) 0.718 (0.077, 1.358)
	HC 20	19.9	-	-			
*Russell et al. (1992)	AN 54	15.4	-	NR	Parental Bonding Instrument	Lower Parental Care Higher Parental Overprotection	0.027 (-0.350, 0.404) 0.314 (-0.694, 0.065)
	HC 54	15.2	-	-			
*Steiger et al. (1989)	AN 23 BN 32	29.72 (7.57)	-	NR	Parental Bonding Instrument	Lower Parental Care	0.578 (-0.080, 1.236) 0.700 (0.096, 1.304)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
		25.66 (5.07)				Higher Parental Overprotection	0.334 (-0.316, 0.983)
	HC 24	28.04 (5.93)	-	-			0.167 (-0.420, 0.753)
*Striegel-Moore et al. (2005)	BED 106	-	-	-	Parental Bonding Instrument	Lower Parental Care	0.274 (0.001, 0.547)
	HC 102	-	-	-		Lower Parental Overprotection	0.281 (-0.558, 0.005)
*Swanson et al. (2010)	AN 43	24.67 (6.81)	13.99	NR	Parental Bonding Instrument	Lower Parental Care	0.460 (0.082, 0.839)
	HC 76	20.5 (5.1)	23.3	-		Higher Parental Overprotection	0.167 (-0.207, 0.542)
Tchanturia et al. (2012)	AN 72	25.7 (7.5)	14.5 (1.8)	Agoraphobia 12 Panic Disorder 16 Social Phobia 22 OCD 15 GAD 36	Social Anhedonia Scale	Higher Social Anhedonia	1.478 (1.057, 1.899)
	BN 19	31.0 (11.7)	21.0 (2.1)	Panic Disorder 2 Agoraphobia 2 Social Phobia 6 OCD 2 GAD 6		Higher Social Anhedonia	1.953 (1.313, 2.593)
	HC 44	26.5 (8.8)	21.6 (1.7)	-			
*Tereno et al. (2008)	AN 30	19.27 (3.44)	NR	NR	Adult Attachment Scale	Lower security Insecurity	0.632 (0.132, 1.132) 1.228 (0.696, 1.761)
						Lower security Insecurity	0.552 (0.041, 1.064) 1.323 (0.768, 1.878)
	BN 27	21.63 (3.62)	NR	NR			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 35	18.97 (2.97)	NR	NR			
*Troisi et al. (2005)	AN 37	NR	NR	ANR 13 ANBP 6 EDNOS History of BN/AN	Attachment Style Questionnaire	Lower security Insecurity	0.709 (0.292, 1.126) 0.726 (0.309, 1.144)
					Separation Anxiety Symptom Inventory	Separation Anxiety	0.659 (0.244, 1.074)
	BN 41	NR	NR	BNP 29 BN-nonP 2 EDNOS History of BN/AN	Attachment Style Questionnaire	Lower security Insecure	0.508 (0.109, 0.906) 0.502 (0.104, 0.900)
	HC 64	23.0 (2.81)	NR		Separation Anxiety Symptom Inventory	Separation Anxiety	0.581 (0.181, 0.981)
*Vandereycken (1994)	AN 40	18.8	-	-	Parental Bonding Instrument	Higher Parental Care	0.557 (-0.953, 0.162)
	HC 228	-	-	-		Higher Parental Overprotection	0.071 (-0.321, 0.464)
*Wade et al. (2007)	AN 23 BN 20	35	-	NR	Parental Bonding Instrument	Lower Parental Care	0.229 (0.192-0.650) 0.305 (0.145, 0.754)
	HC 43	-	-	-		Lower Parental Overprotection	0.357 (-0.064, 0.778)
						Higher Parental Overprotection	0.038 (-0.488, 0.411)
Ward et al. (2000)	ED 127	27.9 (9.2)	NR	NR	Reciprocal Attachment Questionnaire	Higher differentiation of attachment from other relationships	0.110 (-0.170, 0.390)
	HC 80	25.7 (7.0)	NR	NR		Higher insight	0.350 (0.069, 0.632)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
						into provisions of attachment	
						Dysfunctional attachment behaviour	0.376 (0.094, 0.658)
Ward et al. (2001)	AN 20	Median 22	14.5 (2.5)	NR	Adult Attachment Interview	More Probable Experience of Negative Attachment	1.034 (0.526, 1.541)
	HC 85	NR	NR	NR		Less Probable Experience of Positive Attachment	1.338 (-0.818, 1.858)
						Lower State of Mind	0.143 (-0.344, 0.631)
						Less Coherence of Transcript	2.371 (1.786, 2.956)
*Yamaguchi et al. (2000)	ED 51	21.2 (5.25)	-	NR	Parental Bonding Instrument	Lower Parental Care	0.522 (0.180, 0.863)
	HC 105-106	22.8 (6.16)	-	-		Higher Parental Overprotection	0.421 (0.082, 0.761)
(2a) 'Reception of Facial Communication'							
Castro et al. (2010)	AN 30	25.2 (7.2)	14.7 (1.4)	-	Facial Recognition Task (happy and sad)	Faster reaction time	0.355 (-0.122, 0.833)
	HC 40	30.2 (11.9)	22.5 (2.2)	-			
Cserjesi et al. (2011)	AN 33	21.8 (3.4)	14.8 (1.3)	-	Attentional Bias (happy, sad and angry)	Lower facilitation effect to happy	0.036 (-0.457, 0.385)
	HC 63	35.7 (7.5)	21.6 (1.55)	-		Lower facilitation effect to sad and angry	0.248 (-0.174, 0.671)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
Goddard et al. (2013) (A)	ED 65	21.8 (5.5)	16.8 (2.5)	AN 47 BN 6 EDNOS 12	Emotional-Stroop Task (angry)	Larger social threat interference effect	0.104 (-0.394, 0.601)
	HC 50	21.5 (5.9)	21.1 (2.0)	-			
Goddard et al. (2013) (B)	ED 28	26.2 (8.2)	17.7 (2.2)	-	Emotional-Stroop Task (angry)	Similar social threat bias as HC	0.107 (-0.262, 0.476)
	HC 35	26.4 (7.2)	23.2 (2.5)	-			
Harrison et al. (2010a; 2010b)	AN 50	26.7 (9.82)	15.38 (1.83)	ANR 35 ANBP 15	Emotional-Stroop Task (angry)	Higher interference effect	1.016 (0.651, 1.382)
	BN 50	27.54 (8.82)	20.98 (2.35)	NR			0.878 (0.517, 1.239)
	HC 90	28.50 (9.93)	21.61 (1.89)	-			
*Kessler et al. (2006)	AN 48	22.9 (7.7)	16.3 (1.9)	NR	Facially Expressed Emotion Labelling Task (happy, sad, angry, fear, disgust, surprise)	Poorer emotion recognition	0.194 (-0.166, 0.555)
	BN 31	25.5 (8.4)	21.6 (4.1)	NR		Superior emotion recognition	-0.024 (-0.440, -0.392)
	HC 78	22.8 (5.8)	NR	-			
*Kucharska-Pietura et al. (2004)	AN 30	20.2 (4.4)	15.2 (1.7)	ANR 23 ANBP 7	Emotion Recognition Experiment (happy, sad, angry, fear, disgust, contempt, interest, surprise, shame)	Poorer emotion recognition	0.812, (0.285, 1.339)
	HC 30	25.2 (4.0)	NR	-			
*Legenbauer et al. (2008)	BN 20	22.65 (4.36)	20.77 (2.26)	MDD 7	Facial Recognition Task for Expressed Emotions (happy, sad, angry, fear, disgust, contempt, surprise)	Poorer emotion recognition	0.006 (-0.613, 0.626)
	HC 20	23.95 (3.12)	20.49 (1.46)	-			
*Mendlewicz et al. (2005)	AN 36	19.5 (3.8)	15.4 (2.1)	ANR 20 ANBP 16	Emotion Facial Expressions Task	Poorer emotion recognition	0.433 (-0.049, 0.915)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 32	21.1 (2.1)	20.4 (2.3)	-			
Rozenstein et al. (2011)	AN 34	23.11 (7.65)	17.82 (1.9)		Emotional Matching Task	More errors matching emotions	0.531 (0.022, 1.085)
	BN 19	21.93 (1.8)	23.0 (7.6)			More errors matching emotions	0.635 (0.006, 1.263)
	HC 23	21.64 (3.5)	23.68 (5.9)				
*Zonnevylle-Bender et al. (2004b)	AN 48	15.5 (1.1)	14.8 (3.3)	NR	Emotion Recognition Task (happy, sad, angry, fear, disgust, contempt, surprise)	Poorer emotion recognition	0.246 (-0.156, 0.647)
	HC [a] 48	15.4 (1.3)	NR	NR			
*Zonnevylle-Bender et al. (2004b)	AN 23	21.3 (3.1)	15.7 (1.4)	NR	Emotion Recognition Task (happy, sad, angry, fear, disgust, contempt, surprise)	Poorer emotion recognition	0.056 (-0.441, 0.553)
	HC [a] 48	15.4 (1.3)	NR	NR			
*Zonnevylle-Bender et al. 2002	ED 30	AN 14.9 BN 16.8 EDNOS 16.2	AN 15.4 BN 21.3 EDNOS 20.3	AN 16 BN 8 EDNOS 6	Emotion Recognition Task (happy, sad, angry, fear, disgust, contempt, surprise)	Poorer emotion recognition	0.513 (0.003, 1.024)
	HC 31	16.1	19.5	NR			
(2b) 'Production of Facial Communication'							
Davies et al. (2011)	AN 30	Median 24.5 (19-33.5)	Median 14.6 (12.9-15.6)	-	Facial Expression (congruent expression to valence of stimuli observed)	Less expression: More avoidance:	1.562 (0.999, 2.124) 0.927 (0.410, 1.444)
	HC 34	Median 23 (19-31.5)	Median 21 (20.1-22)	-			
Rhind et al. (submitted)	AN 16	14.75 (1.65)	17.03 (2.40)	-	Facial Expression (congruent expression to valence of stimuli observed)	Less expression: More avoidance:	1.683 (0.882, 2.484) 0.700 (-0.005, 1.404)
	HC 17	14.41 (1.28)	19.97 (1.10)	-			
Claes et al. (2012)	AN 11	32.5 (9.7)	16.3 (1.4)	-	Playmancer: Facial feature tracking	Expression: (joy and anger)	0.549 (1.401, 0.304)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	BN 12	29.2 (10.5)	26.7 (5.8)	-	Playmancer: Facial feature tracking	Expression: (joy and anger)	0.156 (0.975, 0.664)
	HC 11	28.1 (5.4)	NR	-			
(2c) 'Reception of Non Facial Communication'							
Jones-Chesters et al. (1998)	BN 16	25.25 (7.66)	23.77 (3.02)	NR	Stroop task (emotional words)	More interference effect from emotional words	0.822 (0.099, 1.549
	HC 16	26.55 (7.47)	22.12 (2.76)	-			
Joos et al. (2009)	AN 15	25 (4.5)	16.2 (1.2)		Visual Emotional Stimuli	Lower ratings of emotional experience	0.669 (0.012, 1.327)
	BN 19	25.4 (6.4)	22.2 (4.6)			Lower ratings of emotional experience	0.362 (-0.964, 0.239)
	HC 25	27.4 (5.5)	21.3 (1.9)				
Kucharska-Pietura et al. (2004)	AN 30	20.2 (4.4)	15.2 (1.7)	ANR 23 ANBP 7	Voice Emotion Recognition Test	Lower emotion recognition	1.321 (0.761, 1.882)
	HC 30	25.2 (4.0)	NR	-			
Nandrino et al. (2012)	AN 16	21.7 (4.2)	15.5 (1.03)	-	Categorization task of visual emotional stimuli	Less accurate at categorising emotional stimuli	0.842 (0.155, 1.529)
	HC 20	20.45 (1.73)	21.2 (2.2)	-			
					Activation Rating Task of visual emotional stimuli	Higher ratings of emotional intensity	0.500 (0.168, 1.168)
(2d) 'Production of Non Facial Communication'							
Davies et al. (2012)	AN 42	25.6 (6.5)	14.8 (1.8)	NR	Emotion Talk (happy, sad and angry talk)	Less verbal self-generated emotion expression	0.118 (0.571, 0.335)
	BN 26	25.9 (8.0)	21.5 (2.0)	NR	Emotion Talk (happy, sad and angry talk)	Less verbal self-generated	0.079 (0.590, 0.431)
	HC 34	26.3 (8.4)	21.6 (1.4)	-			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
						emotion expression	
Mangweth et al. (1999)	AN 36	28.5 (8.9)	NR	NR	Questionnaire of Adult Crying	Less crying proneness	0.270 (0.691, 0.150)
	BN 31	25.3 (7.8)	NR	NR	Questionnaire of Adult Crying	More crying proneness	0.229 (0.212, 0.669)
	HC 56	27.0 (8.5)	NR	NR			
Stein et al. (2001)	ED 34	NR	NR	BN 6 EDNOS 12 Sub-BN 3 Sub-EDNOS 1 Sub-BN/AN 13	Mother with eating disorder and her child: Event-Sampled Observations	Less gentle control behaviours More strong control behaviours	0.328 (0.094, 0.750,) 0.725 (0.293, 1.157)
	HC 61	NR	NR	NR			
(3a) 'Agency'							
*Epstein et al. (2001)	AN 20	15.63 (2.43)	NR	NR	Proprioception Task	Poorer proprioception	0.316 (-0.308, 0.940)
	HC 20	21.08 (2.29)	NR	NR			
*Eshkevari et al. (2012)	AN 36	23.0	16.1 (2.71)	-	Rubber Hand Illusion Task	Poorer proprioception More embodiment	0.413 (-0.003, 0.829) 0.387 (-0.029, 0.803)
	BN 22	22.5	20.9 (4.28)	-		Poorer proprioception More embodiment	0.467 (-0.026, 0.959) 0.545 (0.050, 1.039)
	EDNOS 20	27.5	19.7 (5.54)	-		Poorer proprioception	0.254 (-0.253, 0.761)
	ED Rec	25.5 (8)	27 (2.7)	AN 20 BN 6 EDNOS 2		More embodiment Poorer	0.646 (0.131, 1.161) 0.173 (-0.275, 0.621)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
						proprioception More embodiment	0.586 (0.130, 1.042)
	HC 61	24.0	21.5 (2.80)	-			
*Guardia et al. (2012)	AN 25	24.3 (6.4)	15.14 (1.52)	-	Subjective Vertical Task	Impaired spatial orientation	0.458 (-0.104, 1.020)
	HC 25	23.04 (5.98)	21.0 (1.99)	-			
*Keizer et al. (2012)	AN 25	24.15 (4.24)	18.96 (2.18)	AN 11 EDNOS 14	Tactile Estimation Task	Larger tactile distances estimation	1.469 (0.859, 2.079)
					Two Point Discrimination	Larger receptive fields of tactile acuity	0.522 (-0.027, 1.071)
					Von Frey Task	More perceptive of pressure on skin	0.334 (0.209, 0.787)
	HC 28	22.54 (2.52)	21.30 (1.76)	NR			
Legenbauer et al. (2011)	BED 15	33.8 (10.5)	42.5 (8.5)	Depressive syndromes 9 Dysthymia 1 Social phobia 1 Specific phobia 1 Panic disorder	Motion Distortion Technique	Perceived actual motion patterns as consistent to BMI above 40	0.156 (-0.561, 0.873)
						"felt" motion patterns as consistent to	0.390 (-0.333, 1.113)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
				1 Somatoform pain disorder 1		BMI above 40 "Ideal" walking pattern that consistent with a BMI of over 20	0.740 (-0.002, 1.481)
	HC 15	40.7 (9.4)	43.0 (7.6)	Depressive syndromes 5 Panic disorder 2 Social phobia 1 Agoraphobia 1 Somatisation disorder 2 Psychogenic dizziness 1			
*Papezova et al. (2005)	AN 16	ANR 23.1 (3.4) ANBP 26.6 (5.0)	ANR 14.8 (2.2) ANBP 15.8 (1.3)	ANR 16 ANBP 5 Affective Disorder Anxiety Disorder Substance Abuse	Pain Threshold Measurement	Higher pain threshold	0.486 (-0.208, 1.179)
					Somatoform dissociation questionnaire	More somatoform dissociation	0.486 (-0.207, 1.179)
	BN 18	25.2 (6.4)	20.6 (2.9)	Affective Disorder Anxiety Disorder Substance Abuse	Pain Threshold Measurement	Higher pain threshold	0.818 (0.127, 1.510)
					Somatoform dissociation questionnaire	More somatoform dissociation	0.942 (0.241, 1.643)
	HC 17	23.2 (2.9)	22.3 (2.2)	NR			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
*Pollatos et al. (2008)	AN 28	21.4 (4.8)	16.6 (1.2)	MDD 9 MDD/anxiety 2 Anxiety Disorder 2	Heartbeat Perception Task	Poorer perception of own heartbeat	0.558 (0.024, 1.092)
	HC 28	22.4 (2.4)	21.5 (4.3)	-			
Vocks et al. (2007)	BN 30	26.57 (6.68)	20.85 (1.94)	NR	Photo Distortion Technique (dynamic image)	Perceived own	0.543 (0.090, 0.995)
	HC 55	24.62 (4.67)	21.14 (1.86)	NR		"actual" BMI 26 "felt" own BMI 29	0.883 (0.418, 1.348)
						"Ideal" BMI would be 19	0.043 (-0.401, 0.488)
Zucker et al. 2013	AN 20	25.6 (8.7)	17.5 (1.3)	-	Sensory Profile	Higher sensation registration and sensitivity	1.075 (0.439, 1.712)
						More sensation avoidance	1.086 (0.449, 1.723)
						Less sensation seeking	0.317 (0.281, 0.914)
	AN-Rec 15	27.4 (10.1)	22.6 (3.8)	-		Higher sensation registration and sensitivity	0.963 (0.281, 1.644)
	HC 24	26.6 (9.8)	22.6 (3.8)	-		More sensation avoidance	1.007 (0.322, 1.691)
						Less sensation seeking	0.254 (0.901, 0.394)
(3b) 'Self-Knowledge'							
*Adenzato et al. (2012)	AN 30	19.73 (6.06)	15.06 (1.74)	ANR 16 ANBP 14	Toronto Alexithymia Scale	High alexithymia	1.533 (0.964, 2.101)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 32	20.47 (2.72)	20.21 (1.45)	-			
*Bachner-Melman et al. (2006)	AN 31	23.1 (5.2)	16.7 (1.2)	NR	Rosenberg Self-Esteem Scale Self-Rated Attractiveness	Lower self-esteem Lower rated attractiveness	1.101 (0.716, 1.485) 1.343 (0.953, 1.733)
	HC 248	23.1 (2.7)	22.0 (3.2.)	NR			
*Bachner-Melman et al. (2007)	AN 17	23.0 (2.94)	16.82 (0.98)	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	1.843 (1.327, 2.360)
	AN-Rec 71	23.73 (3.44)	21.50 (1.97)	NR		Lower self-esteem	0.677 (0.407, 0.947)
	HC 242	23.91 (2.58)	21.91 (2.89)	NR			
*Beadle et al. (2013)	AN 26	24.4 (5.5)	15.7 (2.0)	Depressive disorder 19.2 % BPD 15.4 %	Toronto Alexithymia Scale	Higher alexithymia	2.224 (1.434, 3.015)
	HC 16	24.8 (5.4)	25.0 (4.7)	NR			
*Beato et al. (2003)	ED 118	22.5 (6.94)	NR	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	1.679 (1.329, 2.030)
	HC 64	22.17 (2.04)	NR	NR			
*Berg et al. (2008)	BN 96	NR	NR	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	1.144 (0.943, 1.344)
	HC 37,687	NR	NR	NR			
*Blaase & Elklit (2001)	ED 22	19 – 34	NR	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	1.718 (1.087, 2.349)
	ED-Rec 20	21 – 37	NR	NR		Lower self-esteem	0.167 (-0.390, 0.723)
	HC 33	19 – 46	NR	NR			
*Blechert et al. (2011)	AN 20	23.1 (4.64)	16.8 (0.81)	-	Rosenberg Self-Esteem Scale	Lower self-esteem	1.505 (0.854, 2.156)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	BN 20	26.5 (7.78)	22.5 (3.38)	-		Lower self-esteem	1.430 (0.786, 2.074)
	HC 28	25.4 (4.80)	20.8 (2.50)	-			
*Bourke et al. (1992)	AN 48	24.7 (6.3)	NR	ANR 30 AN/BN 18	Toronto Alexithymia Scale	Higher alexithymia	1.928 (1.379, 2.478)
	HC 30	26.8 (4.1)	NR	NR			
*Brytek-Matera (2007)	AN 32	17.66 (1.30)	16.69 (2.31)	NR	Self-Esteem Inventory Self-Expression Control Scale	Lower self-esteem More anger towards self	0.943 (0.488, 1.398) 0.202 (-0.232, 0.636)
	HC 37	20.84 (1.91)	21.41 (2.82)	NR			
*Bydlowski et al. (2005)	AN 33	NR	NR	ANR 18 ANBP 15	Levels of Emotional Awareness	Lower emotional awareness	1.097 (0.656, 1.537)
	BN 37	NR	NR	NR		Lower emotional awareness	0.500 (0.096, 0.904)
	HC 70	19.3 (1.9)	NR	NR			
*Ciccolo & Johnsson (2002)	ED 52	23	NR	ANR 14 ANBP 7 BNP 25 BNnonP 6	Tennessee Self-Concept Scale	Negative self-concept	1.930 (1.470, 2.391)
	HC 54	22	NR				
*Cochrane et al. (1993)	AN 19	28.1 (9.3)	NR	NR	Toronto Alexithymia Scale	Higher alexithymia	0.996 (0.530, 1.463)
	BN 52	28.2 (12.1)	NR	NR		Higher alexithymia	1.223 (0.921, 1.524)
	EDNOS 43	38.6 (11.8)	NR	NR		Higher alexithymia	1.363 (1.034, 1.692)
	HC 370	NR	NR	NR			
*Cockerham et al. (2009)	BN-BED 20	23.05 (5.23)	22.98 (5.35)	BN 17 BED 3	Rosenberg Self-Esteem Scale	Lower self-esteem	-1.682 (0.956, 2.408)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 20	20.55 (4.21)	21.75 (3.15)	NR			
Cooper et al. (2007)	AN 16	29.6 (11.4)	18.4 (3.1)	ANR 6 ANBP 10	Metacognitions Questionnaire	More positive beliefs	0.263 (-0.423, 2.948)
	HC 17	26.2 (9.5)	21.0 (1.7)	NR		More uncontrollability and danger	1.667 (0.868, 2.466)
						More cognitive confidence	1.465 (0.691, 2.239)
						More need for control	1.953 (1.115, 2.791)
						More cognitive self-consciousness	1.105 (0.369, 1.841)
*Daley et al. (2008)	BN 42	BN 23.2 (4.5) Rec-BN 27.3 (6.1)	BN 22.7 (1.5) Rec-BN 22.3 (1.4)	BN 22 Rec-BN 20	State Self-Esteem Scale	Lower self-esteem	1.951 (1.430, 2.473)
	HC 42	22.5 (3.2)	22.1 (1.9)	-			
*de Groot et al. (1995)	BN 31	26.0 (5.8)	NR	NR	Toronto Alexithymia Scale	Higher alexithymia	1.408 (0.780, 2.035)
	HC 20	30.9 (5.4)	NR	NR			
*de Panfilis et al. (2003)	ED 64	AN 28.0 (9.0) BN 26.8 (7.4) BED 38.4 (12.5)	AN 16.5 (1.6) BN 22.3 (5.6) BED 34.6 (6.2)	ANR 4 ANBP 12 BNP 20 BED 28	Toronto Alexithymia Scale	Higher alexithymia	0.681 (0.330, 1.032)
	HC 68	29.8 (8.9)	21.4 (1.3)	-			
*de Zwaan et al. (1993)	BED 43	38.8 (7.6)	36.1 (3.7)	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	-0.691 (0.164, 1.219)
	HC 22	40.0 (8.7)	34.3 (3.4)	NR			
*de Zwaan et al. (1995)	BED 83	39.3 (7.0)	36.2 (3.9)	NR	Toronto Alexithymia Scale	Higher alexithymia	0.187 (-0.105, 0.479)
	HC 99	41.1 (8.9)	36.3 (4.5)	NR			
*de Zwaan et al. (1996)	AN 22	22.2 (4.7)	14.9 (1.7)	-	Toronto Alexithymia Scale	Higher alexithymia	1.742 (1.104, 2.380)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	BN 18	23.9 (4.1)	20.7 (2.7)	-		Higher alexithymia	1.365 (0.727, 2.004)
	HC 32	24.0 (3.6)	22.3 (3.6)	-			
*Deborde et al. (2008)	ED 47	22 (5.8)	NR	BN 30 ANR 10 ANP 7	BVAQFB Toronto Alexithymia Scale	Higher alexithymia Higher alexithymia	1.272 (0.944, 1.600) 1.328 (0.999, 1.657)
	HC 253	25 (9.0)	NR	-			
*Dykens & Gerrard (1986)	BN 29	18.33	20.7	NR	Tennessee Self-Concept Scale	Lower self-concept	0.419 (0.111, 0.949)
	HC 27	18.39	19.0	NR			
*Eizaguirre et al. (2003)	AN 69	ANR 21.08 (7.39) AN/BN 20.77 (4.74)	ANR 16.96 (1.13) AN/BN 17.02 (0.99)	ANR 25 AN/BN 44	Toronto Alexithymia Scale	Higher alexithymia	1.971 (1.510, 2.433)
	BN 82	23.01 (5.35)	22.19 (3.44)	NR		Higher alexithymia	1.428 (1.018, 1.838)
	HC 43	21.51 (5.97)	22.30 (2.36)	NR			
Forbush & Watson (2006)	ED 25	30.16 (10.43)	AN 16.74 (2.42) BN 23.36 (5.86)	AN 14 BN 11	Public and Private Self-Consciousness Questionnaire	More Self-Consciousness	1.562 (0.959, 2.166)
	HC 31	19.81 (2.93)	23.67 (5.38)	NR			
*Geller et al. (1998)	ED 48	27.09 (8.59)	19.09 (4.41)	AN 23 BN 18 EDNOS 7	Rosenberg Self-Esteem Scale	Lower self-esteem	1.680 (1.268, 2.091)
	HC 82	20.95 (6.66)	21.72 (3.08)	NR			
*Geller et al. (2000)	AN 21	29.0 (9.21)	15.3 (1.95)	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	3.076 (2.170, 3.982)
	HC 21	28.7 (8.36)	22.1 (3.05)	NR			
Grissett & Norvell (1992)	BN 21	20.3	22.0	NR	Social Competence Questionnaire	Lower self-competence	0.746 (0.119, 1.372)
	HC 21	NR	NR	NR			
Hambrook et al. (2011)	AN 40	27.33 (11.15)	16.57 (1.26)	ANR 12 ANBP 9 EDNOS/AN 19	Silencing the Self Scale	More self-silence	0.959 (0.515, 1.402)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 48	31.90 (9.83)	23.34 (2.84)	-			
*Hilbert et al. (2002)	BED 30	32.3 (11.3)	26.7 (5.1)	NR	State Self-Esteem Scale-Appearance	Lower self-esteem	1.313 (0.753, 1.872)
	HC 30	30.4 (9.6)	25.5 (4.5)	-			
*Jacobi et al. (2004)	AN 33	25.2 (6.9)	15.0 (1.1)	ANBP 63.6% ANR 36.4%	Frankfurt Self-Concept Scales	Negative self-concept	2.486 (1.839, 3.132)
	BN 38	26.1 (7.8)	21.6 (3.1)	BNP 71.1% BNnonP 28.9%		Negative self-concept	2.240 (1.664, 2.817)
	BED 28	32.8 (9.6)	40.2 (8.4)	NR		Negative self-concept	3.025 (2.251, 3.800)
	HC 33	NR	NR	NR			
Jänsch et al. 2009	AN 28	27.11 (7.51)	16.36 (1.31)	-	Emotional Words Categorisation Task	Longer reaction times to make self-reference judgement	0.804 (0.258, 1.349)
	HC 28	28.21 (7.03)	23.50 (3.76)	No history of an ED or other psychiatric disorder			
*Jimerson et al. (1994)	BN 20	25 (4)	NR	-	Toronto Alexithymia Scale	Higher alexithymia	2.615 (1.761, 3.469)
	HC 20	24 (4)	NR	-			
Joiner et al. (1997)	BN 23	22.27	NR	NR	Beck Depression Inventory	Negative Self-Esteem	2.589 (1.861, 3.317)
	HC 32	22.42	NR	NR			
*Kessler et al. (2006)	AN 48	22.9 (7.7)	16.3 (1.9)	NR	Toronto Alexithymia Scale	Higher alexithymia	1.390 (0.991, 1.789)
	BN 31	25.5 (8.4)	21.6 (4.1)	NR			1.699 (1.224, 2.173)
	HC 78	22.8 (5.8)	NR	-		Higher alexithymia	
*Kiezebrink et al. (2009)	AN 428	ANR 28.2 (7.38) ANBP 28.6 (7.13) ANe 27.1 (7.36)	ANR 16.1 (2.23) ANBP 15.7 (2.26) ANe 15.8 (2.12)	ANR 197 ANBP 132 ANe 99	Rosenberg Self-Esteem Scale	Lower self-esteem	0.833 (0.624, 1.042)
	HC 119	25.6 (6.42)	21.9 (2.02)	NR			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
*Kuhnpast et al. (2012)	BN 13	24.6 (7.1)	21.7 (3.7)	Affective Disorder 3 Anxiety Disorder 6 Depression/Anxiety 2	Toronto Alexithymia Scale	Higher alexithymia	2.344 (1.329, 3.359)
	HC 13	25.4 (3.2)	21.6 (2.0)	-			
*Leung & Price (2007)	ED 35	23.5 (5.33)	21.5 (8.23)	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	3.010 (2.316, 3.705)
	HC 34	26.0 (4.59)	22.7 (3.09)	NR			
*McFarlane et al. (2001)	ED 34	34.70 (12.46)	27.47 (8.50)	NR	Rosenberg Self-Esteem Scale State Self Esteem	Lower self-esteem Lower self-esteem	1.639 (1.087, 2.190) -11.922 (-14.010, -9.833)
	HC 34	19.97 (2.24)	24.09 (4.56)	NR			
*Mendelson et al. (2002)	ED 74	28.09 (9.15)	19.67 (4.74)	ANR/EDNOS-ANR 19 BN/ANBP/BED/EDNOS-BP 57	Rosenberg Self-Esteem Scale	Lower self-esteem	1.804 (1.450, 2.157)
	HC 103	21.96 (5.02)	21.46 (4.00)	NR			
*Miyake et al. (2012)	AN 30	27.2 (6.5)	15.4 (1.7)	-	Toronto Alexithymia Scale	Higher alexithymia	2.122 (1.414, 2.829)
	HC 20	25.6 (4.6)	19.3 (1.9)	-			
*Morrison et al. (2003)	AN 53	ANR 26.8 (9.06) ANBP 29.1 (8.72)	ANR 15.6 (2.66) ANBP 15.4 (1.76)	ANR 29 ANBP 24	Rosenberg Self-Esteem Scale	Lower self-esteem	2.311 (1.921, 2.700)
	BN 39	28.3 (9.05)	22.2 (4.84)	NR		Lower self-esteem	2.139 (1.722, 2.556)
	HC 144	22.9 (4.10)	21.4 (2.78)	NR			
*Nandrino et al. (2006)	AN 25	23.7 (6.4)	15.0 (1.26)	-	Toronto Alexithymia Scale	Higher alexithymia	2.115 (1.417, 2.812)
	HC 25	23.56 (4.87)	NR	-			
*Nandrino et al. (2012)	AN 16	21.7 (4.2)	15.5 (1.03)	-	Toronto Alexithymia Scale	Higher alexithymia	1.811 (1.025, 2.597)
	HC 20	20.45 (1.73)	21.2 (2.2)	NR			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
*Napolitano et al. (2001)	BED 26	BED 45.61 (17.95) BED-NES 43.46 (14.15)	BED 41.06 (8.02) BED-NES 44.12 (14.87)	BED 13 BED-NES 13	Rosenberg Self-Esteem Scale	Lower self-esteem	0.530 (-0.118, 1.178)
	HC 34	54.02 (12.54)	40.11 (10.24)	NR			
Oldershaw et al. (2009)	AN 39	27.3 (10.0)	16.6 (1.3)	NR	Levels of Emotional Awareness	Lower emotional awareness	0.359 (0.106, 0.825)
	AN-Rec 22	29.9 (7.7)	20.8 (2.0)	NR		Lower emotional awareness	0.180 (-0.342, 0.703)
	HC 44	29.8 (8.0)	23.0 (2.8)	-			
*Parling et al. (2010)	AN 35	21.60 (4.6)	18.98 (2.2)	NR	Levels of Emotional Awareness Toronto Alexithymia Scale	Lower emotional awareness	0.082 (-0.387, 0.551)
	HC 35	22.60 (5.3)	22.02 (2.2)	-		Higher alexithymia	1.116 (0.611, 1.621)
*Paterson et al. (2007)	AN 27	26.5 (7.87)	18.0 (3.3)	NR	Self-Liking/Competence Scale	Lower self-liking	1.488 (0.985, 1.991)
	HC 62	23.1 (7.8)	23.5 (3.5)	NR			
*Paterson et al. (2011)	AN 55	24.58 (6.80)	14.59 (2.23)	NR	Multi-Dimensional Self-Esteem Inventory	Lower self-esteem	1.096 (0.685, 1.507)
	HC 50	26.71 (7.15)	24.68 (3.90)	NR			
*Pinaquy et al. (2003)	BED 40	38.1	36.8	NR	Toronto Alexithymia Scale	Higher alexithymia	0.407 (0.049, 0.764)
	HC 129	40.4	35.7	NR			
*Pollatos et al. (2008)	AN 28	21.43 (2.38)	16.59 (1.16)	ANR 23 ANBP 5 MDD 9 MDD/Anxiety 2 Anxiety Disorder 2	Toronto Alexithymia Scale	Higher alexithymia	1.623 (1.017, 2.230)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 28	22.39 (4.78)	21.49 (4.28)	-			
*Rosen & Ramirez (1998)	ED 45	25.0 (7.5)	22.2 (5.0)	AN 11 BN 34	Rosenberg Self-Esteem Scale	Lower self-esteem	2.207 (1.694, 2.720)
	HC 50	35.2 (12.0)	24.3 (4.9)	NR			
*Sassaroli et al. (2008)	ED 55	32.71 (7.76)	NR	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	0.441 (-0.023, 0.860)
	HC 38	30.02 (9.29)	NR	NR			
*Schulte-Ruther et al. (2012)	AN 18	15.7 (1.5)	15.3 (1.5)	ANR 13 ANBP 6 OCD 1	Toronto Alexithymia Scale	Higher alexithymia	1.069 (0.378, 1.761)
	HC 19	15.8 (1.9)	22.7 (3.9)	-			
*Senra et al. (2007)	ED 123	19.16 (3.04)	NR	ANR 16 ANBP 46 BNP 63 BNnonP 10	Rosenberg Self-Esteem Scale	Lower self-esteem	1.538 (1.254, 1.822)
	HC 124	20.01 (2.86)	NR	NR			
*Schmidt et al. (1993)	AN 80	ANR 23.6 (5.7) AN/BN 22.4 (5.9)	ANR 15.8 (2.3) AN/BN 17.6 (2.0)	ANR 55 AN/BN 25	Toronto Alexithymia Scale	Higher alexithymia	0.867 (0.573, 1.160)
	BN 73	23.8 (5.1)	21.3 (2.6)	-		Higher alexithymia	0.683 (0.370, 0.997)
	HC 95	21.1 (2.75)	NR	-			
*Soussignan et al. (2011)	AN 17	26.5 (7.1)	14.9 (1.9)	NR	Toronto Alexithymia Scale	Higher alexithymia	1.648 (0.946, 2.350)
	HC 27	24.7 (6.1)	20.4 (1.8)	NR			
*Speranza et al. (2005)	AN 154	ANR 20.4 (5.3) ANP 21.6 (4.9)	ANR 15.0 (1.8) ANP 15.9 (2.1)	ANR 105 ANP 49	Toronto Alexithymia Scale	Higher alexithymia	0.839 (0.635, 1.044)
	BN 98	23.5 (5.7)	21.2 (3.9)	-		Higher alexithymia	0.672 (0.437, 0.908)
	HC 279	21.8 (5.3)	21.1 (2.8)	NR			
Striegel-Moore et	BN 34	NR	NR	NR	Self-Consciousness	Higher self-	1.692 (1.217, 2.168)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
al. (1993)	HC 67	NR	NR	NR	Scale	consciousness	
*Taylor et al. (1996)	AN 48	24.7 (6.3)	NR	NR	Toronto Alexithymia Scale	Higher alexithymia	1.928 (1.378, 2.478)
	HC 30	26.8 (4.1)	NR	NR			
*Tchanturia et al. (2012)	AN 72	25.7 (7.5)	14.5 (1.8)	Panic Disorder 16 Agoraphobia 12 Social Phobia 22 OCD 15 GAD 36	Toronto Alexithymia Scale	Higher alexithymia	1.882 (1.432, 2.333)
	BN 19	31.0 (11.7)	21.0 (2.1)	Panic Disorder 2 Agoraphobia 2 Social Phobia 6 OCD 6 GAD 6		Higher alexithymia	1.881 (1.245, 2.517)
	AN-Rec 14	25.2 (8.7)	21.1 (1.9)	NR		Higher alexithymia	0.876 (0.251, 1.501)
	HC 43	26.5 (8.8)	21.6 (1.7)	-			
*Telch & Stice (1998)	BED 61	43.5 (8.7)	34.8 (7.0)	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	0.892 (0.518, 1.266)
	HC 60	45.0 (10.1)	32.5 (5.8)	NR			
*Torres et al. (2011)	AN 80	19.21 (5.39)	15.27 (1.49)	NR	Toronto Alexithymia Scale	Higher alexithymia	1.263 (0.924, 1.603)
	HC 80	19.20 (4.76)	21.08 (1.39)	NR			
*Troop et al. (1995)	AN 44	ANR 25.5 (6.5) AN/BN 23.3 (5.3)	ANR 16.2 (2.6) AN/BN 17.7 (1.8)	ANR 29 AN/BN 15	Toronto Alexithymia Scale	Higher alexithymia	1.162 (0.765, 1.558)
	BN 83	24.5 (5.6)	21.3 (2.7)	NR		Higher alexithymia	1.079 (0.749, 1.409)
	HC 79	20.6 (3.1)	NR	NR			
*Vanderlinden et	ED 25	20.88 (2.66)	18.49 (3.39)	ANR 20	Rosenberg Self-	Lower self-	2.016 (1.372, 2.661)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
al. (2009)				ANBP 5 BN 10	Esteem Scale	esteem	
	HC 32	19.87 (2.66)	20.82 (1.97)	NR			
*Wilksch & Wade (2004)	AN 19	20.77 (6.40)	16.05 (1.85)	NR	Self-Perception Profile for Adolescents	Lower self-perception	1.391 (0.696, 2.086)
	HC 21	19.39 (1.90)	20.48 (2.55)	NR			
*Williams et al. (1993)	AN 32	25.1 (6.3)	17	NR	Rosenberg Self-Esteem Scale	Lower self-esteem	2.794 (2.116, 3.473)
	BN 30	26.0 (6.9)	23.3	NR		Lower self-esteem	2.619 (1.951, 3.288)
	HC 35	26.9 (8.4)	22.5	-			
*Zeeck et al. (2011)	BED 20	39.3 (12.7)	42.8 (6.0)	NR	Toronto Alexithymia Scale	Higher alexithymia	1.253 (0.572, 1.934)
	HC 20	39.7 (11.6)	23.1 (2.5)	NR			
*Zonnevylle-Bender et al. (2002)	AN 16	14.9	15.4	NR	Toronto Alexithymia Scale	Higher alexithymia	1.281 (0.630, 1.931)
	BN 8	16.8	21.3	NR		Higher alexithymia	1.101 (0.291, 1.911)
	EDNOS 6	16.2	20.3	NR		Higher alexithymia	0.532 (-0.346, 1.411)
	HC 33	16.1	19.5	NR			
*Zonnevylle-Bender et al. (2004b)	AN 48	15.5 (1.1)	NR	NR	Toronto Alexithymia Scale	Higher alexithymia	0.754 (0.340, 1.168)
	HC 48	15.4 (1.3)	NR	-			
Zotter & Crowther (1991)	BN 15	19.3 (2.1)	MR	NR	Self-monitored Thoughts	More negative Self-Monitored Thoughts	0.583 (0.149, 1.315)
	HC 15	18.5 (0.6)	NR	NR			
(4c) 'Understanding Others'							
*Adenzato et al. (2012)	AN 30	19.73 (6.06)	15.06 (1.74)	ANR 16 ANBP 14	Reading the Mind in the Eyes test Empathy Quotient Questionnaire	Low Theory of Mind Lower empathy	0.377 (-0.125, 0.880) 0.656 (0.145, 1.168)
	HC 32	20.47 (2.72)	20.21 (1.45)	-			
Duchesne et al.	BED 60	NR	38.1	NR	Interpersonal	Lower social	0.260 (0.109, 0.629)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
(2011)	HC 54	NR	21.4 (1.6)	NR	Reactivity Index	skills More psychopatholog y	0.807 (0.424, 1.190)
*Gillberg et al. (2010)	AN 42	32	22.36 (4.55)	NR	Francesca Happe's cartoons	Lower Theory of Mind	0.466 (0.42, 0.890)
	HC 46	32	23.41 (4.21)	NR			
Goddard et al. (2013b)	ED 65	21.8 (5.5)	16.8 (2.5)	AN 47 BN 6 EDNOS 12	Reading the Mind in the Eyes	Lower Theory of Mind	0.029 (-0.397, 0.340)
	HC 50	21.5 (5.9)	21.1 (2.0)	-			
Goddard & Treasure (2013a)	ED 28	26.2 (8.2)	17.7 (2.2)	-	Reading the Mind in the Eyes	Lower Theory of Mind	0.131 (-0.612, 0.350)
	HC 35	26.4 (7.2)	23.2 (2.5)	-			
Guttman & Laporte (2000)	AN 28	22	NR	-	Interpersonal Reactivity Index	Lower social skills More psychopatholog y	0.041 (-0.569, 0.488) 0.235 (-0.269, 0.765)
	HC 27	21	NR	-			
Hambrook et al. (2008)	AN 22	26.73 (4.77)	15.27 (1.22)	NR	Empathy Quotient Questionnaire	Lower empathy	0.026 (-0.536, 0.484)
	HC 45	32.51 (9.63)	23.36 (3.76)	-			
*Harrison et al. (2009)	AN 20	26.25 (5.73)	15.81 (1.15)	NR	Reading the Mind in the Eyes test	Lower Theory of Mind	1.205 (0.529, 1.882)
	HC 20	28.35 (8.46)	21.78 (1.61)	NR			
*Harrison et al. (2010)	AN 50	26.7 (9.82)	15.38 (1.83)	NR	Reading the Mind in the Eyes test	Lower Theory of Mind	0.513 (0.162, 0.864)
	AN-Rec 35	29.00 (10.62)	21.15 (1.76)	NR		Lower Theory of Mind	0.343 (-0.050, 0.736)
	HC 90	28.50 (9.93)	21.61 (1.89)	-			
*Kenyon et al. (2012)	BN 48	28.0 (7.7)	24.5 (7.1)	-	Reading the Mind in the Eyes	Higher Theory of Mind (Film) Lower Theory of Mind (Eyes)	0.184 (0.200, 0.569) 0.354 (-0.033, 0.741)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	EDNOS 34	27.6 (6.9)	25.0 (6.3)	-		Higher Theory of Mind (Film)	0.043 (-0.476, 0.390)
	HC 57	24.0 (2.6)	22.7 (3.2)	-		Lower Theory of Mind (Eyes)	-0.302 (-0.125, 0.729)
*Medina-Pradas et al. (2012)	AN 44	26.80 (5.70)	15.80 (1.70)	-	Reading the Mind in the Eyes	Lower Theory of Mind	0.760 (0.313, 1.207)
	BN 30	26.80 (6.10)	20.90 (2.60)	-		Lower Theory of Mind	0.813 (0.317, 1.308)
	EDNOS 23	26.02 (8.20)	25.80 (8.30)	-		Lower Theory of Mind	0.975 (0.431, 1.519)
	HC 39	26.04 (14.70)	21.30 (2.10)	-			
Morrison et al. (2006)	ED 25	27.3 (6.97)	20.3 (3.25)	BNP 4 BNnonP 3 ANR 2 ANBP 1 EDNOS 15	Internal, Personal and Situational Attributions Questionnaire	Attribute more negative events to others	1.799 (1.144, 2.453)
	HC 26	27.7 (5.62)	22.1 (2.04)	NR			
*Oldershaw et al. (2009)	AN 39	27.3 (10.0)	16.6 (1.3)	NR	Reading the Mind in the Eyes	Lower Theory of Mind (Eyes) Lower Theory of Mind (Voice) Lower Theory of Mind (Film)	0.532 (0.093, 0.971) 0.718 (0.273, 1.163) 0.741 (0.295, 1.187)
	AN-Rec 22	29.9 (7.7)	20.8 (2.0)	NR		Lower Theory of Mind (Eyes)	0.030 (-0.482, 0.542)
	HC 44	29.8 (8.0)	23.0 (2.8)	-		Lower Theory of Mind (Voice) Lower Theory of Mind (Film)	-0.091 (-0.603, 0.421) -0.088 (-0.600, 0.424)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
*Renwick et al. 2013	AN 78	26.4 (7.7)	16.5 (1.2)	-	Interpersonal Perception Task	Similar to HC on social perception	0.006 (-0.360, 0.372)
	BN 57	27.6 (6.4)	25.2 (6.7)	-		Similar to HC on social perception	0.102 (-0.278, 0.482)
	HC 50	24.1 (2.6)	23 (3.1)				
Rupp & Jurkovic (1996)	BN 17	16.90 (1.05)	NR	NR	Perspective-Taking Scale	Higher perspective taking	0.191 (-0.758, 0.375)
	HC 41	16.10 (1.16)	NR	NR			
Rothschild-Yakar et al. (2011)	ED 29	23.34 (3.84)	NR	ANBP 9 BN 20	Social Cognition and Object Relations Scale	Low affect consciousness, view social world as malevolent, and understanding and attribution of causality	1.219 (0.647, 1.792)
	HC 27	23.11 (1.18)	NR	NR			
Rothschild-Yakar et al. (2010)	AN 34	18.20 (2.70)	16.52 (2.40)	Depressive disorder 21 OCD 9	Social Cognition and Object Relations Scale	Lower understanding and attribution of causality and representations are not clearly differentiated	1.022 (0.519, 1.525)
	HC 35	17.80 (2.31)	20.05 (2.10)	-			
*Russell et al. (2009)	AN 22	26.7 (4.8)	15.26 (1.2)	ANR 17 ANBP 5	Reading the Mind in the Eyes Francesca Happe's cartoons	Lower Theory of Mind	1.575 (0.895, 2.255)
	HC 22	30.3 (6.5)	26.2 (2.0)	-		Lower Theory of Mind	1.575 (0.895, 2.255)
Schulte-Ruther et	AN 18	15.7 (1.5)	15.3 (1.5)	ANR 13	Interpersonal	Lower social	0.046 (-0.683, 0.591)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
al. (2012)				ANBP 6 OCD 1	Reactivity Index	skills More psychopatholog y	0.383 (-0.268, 1.026)
	HC 20	15.8 (1.9)	22.7 (3.9)	-			
*Tchanturia et al. (2004)	AN 20	27.4 (7.9)	15.8 (2.2)	NR	Francesca Happe's cartoons	Lower Theory of Mind	1.086 (-0.420, 1.752)
	HC 20	28.3 (7.4)	21.5 (1.5)	NR			
Wittotf et al. (2012)	AN 14	23.9 (5.7)	15.8 (1.9)	-	Internal, Personal and Situational Attributions Questionnaire	Less externalising bias Less personalising bias	0.560 (0.038, 1.158) 0.468 (0.128, 1.063)
	HC 52	31.7 (10.6)	NR	-			
(5) 'Social Dominance'							
*Cardi et al. (2014)	ED 46	27.3 (10.2)	19.0 (4.0)	ANR 20 ANBP 9 BN 17	Other as Shamer Scale Submissive Behaviour Scale	Higher shame Higher submissive behaviour	2.162 (1.656, 2.668) 1.728 (1.257, 2.198)
	ED-Rec 22	29.5 (8.4)	21.8 (2.3)	AN 13 BN 9	Other as Shamer Scale Submissive Behaviour Scale	Higher shame Higher submissive behaviour	0.871 (0.349, 1.392) 0.708 (0.193, 1.223)
	HC 50	25.3 (7.4)	21.7 (1.9)	-			
*Carter et al. (2012)	AN 218	26.0 (7.6)	14.8 (1.8)	ANBP 39 % ANR 61 %	Inventory of Interpersonal Problems	Greater levels of interpersonal difficulties	0.192 (0.027, 0.358)
	HC 400	NR	NR	NR			
*Doran & Lewis (2011)	ED 165	NR	NR	NR	Experience of Shame Scale	Higher shame	1.589 (1.409, 1.770)
	ED-Rec 30	NR	NR	NR		Higher shame	0.406 (0.042, 0.771)
	HC 859	23	NR	NR			

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
*Hartmann et al. (2010)	ED 208	24.5 (7.5)	ANR 14.6 (1.7) ANBN 15.5 (1.6) BN 22.3 (3.9)	ANR 56 BN 95 ANBP 57 Mood disorder 87 Anxiety Disorder 56 Substance Abuse Disorder 16 BPD 22 Mixed/PD-NOS 13 OCPD 10	Inventory of Interpersonal Problems	Greater levels of interpersonal difficulties	0.703 (0.561, 0.844)
	HC 3046	NR	NR	NR			
*Masheb et al. (1999)	BED 72	42.1 (9.7)	34.4 (7.73)	NR	Internal Shame Scale	Higher shame	1.362 (1.002, 1.723)
	HC 74	24.1 (12.0)	NR	-			
*Swan & Andrews (2003)	ED 41	NR	NR	NR	Experience of Shame Scale	Higher shame	2.101 (1.628, 2.574)
	ED-Rec 21	NR	NR			Higher shame	0.825 (0.324, 1.325)
	HC 72	26.2 (10.65)	22.8 (4.52)	NR			
*Troop et al. (2003)	AN 38	ANR 21.6 (4.6) AN/BN 27.3 (9.1)	ANR 16.3 (3.9) AN/BN 17.3 (1.9)	ANR 23 AN/BN 15	Submissive Behaviour Scale Social Comparison Rating Scale	Higher submissive behaviour Higher social comparison	1.213 (0.813, 1.613) 4.980 (4.282, 5.678)
	BN 51	28.5 (7.2)	24.6 (9.1)	NR		Higher	1.441 (1.067, 1.815)

Studies	Group and N	Age: mean (sd)	BMI (sd)	Co-morbidity	Measure	Outcome of measure	Cohen's d (95% C.I.)
	HC 101	26.7 (7.7)	NR	NR		submissive behaviour Higher social comparison	1.504 (1.127, 1.881,)
*Waller et al. (2000)	BN 40	NR	NR	BN 28 AN/BN 12	Young Schema Questionnaire	More dysfunctional level of the core belief	1.884 (1.383, 2.384)
	HC 50	22.1 (3.77)	23.8 (2.32)	NR			

3.6.2. Synthesis of results

The synthesis of results from the meta-analysis and systematic review are described sequentially according to each NIMH RDoC construct/subconstruct. The forest plots produced from the meta-analyses are organised per ED subgroup and subscripts denote the same study with scores for separate ED groups. A qualitative description is provided as a meta-analysis could not be performed due to low numbers of studies for the areas of 'Reception of Non-Facial Communication' and 'Production of Non-Facial communication'. We did not find any articles for the area of 'Action Perception', which is why this subconstruct has been omitted from the results section. Two separate meta-analyses were produced for the areas of Parental Bonding: (a) care; (b) overprotection; and Self-Knowledge: (a) self-evaluation; (b) alexithymia.

3.6.3. Affiliation and attachment

3.6.3.1. Meta-Analysis: Insecure attachment

Eight studies were identified for the area of insecure attachment. Each study measured classic insecure attachment via-self report (Amianto, Abbate-Daga, Morando, Sobrero, & Fassino, 2011; Chassler, 1997; Holliday, Uher, Landau, Collier, & Treasure, 2006; Illing, Tasca, Balfour, & Bissada, 2010; Latzer, Lavee, & Gal, 2009; Miljkovitch, Pierrehumbert, Karmaniola, Bader, & Halfon, 2005; Tereno, Soares, Martins, Celani, & Sarnpaio, 2008; Troisi, Massaroni, & Cuzzolaro, 2005). Figure 1 presents the forest plot for the meta-analysis of insecure attachment. Relative to HC, people with ED report insecure attachment with a large ES 0.91 (95%CI: 0.76, 0.07, $p < .001$). This overall effect remains large even after adjusting with the meta-regression 1.13 ($p < .001$). There was no evidence of publication bias (Begg's test p=.537; Egger's test p=.761).

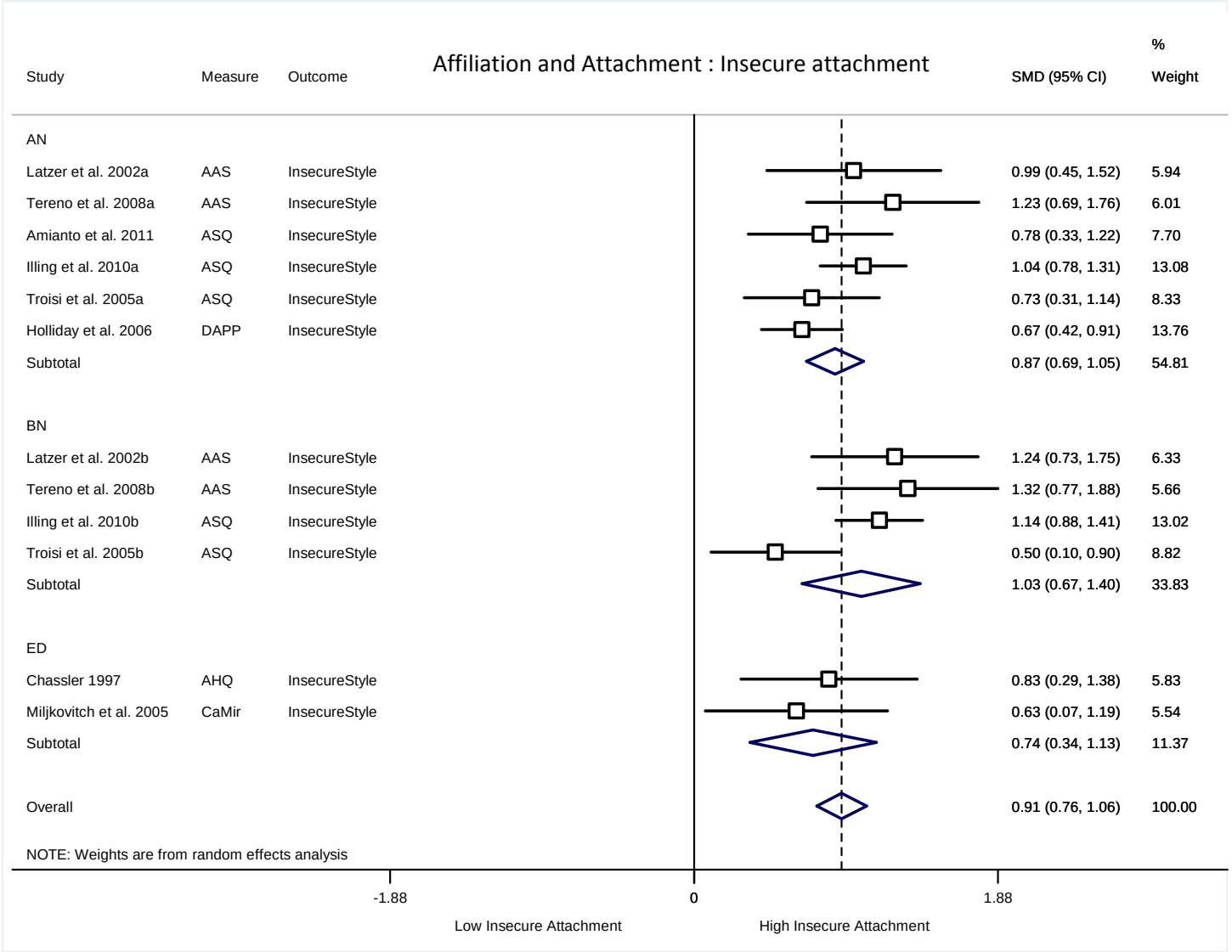

Figure 1. Forest plot for the meta-analysis of insecure attachment measured by self-report in eating disorders. Abbreviations: ASQ=Attachment Style Questionnaire; DAPP=Dimensional Assessment of Personality Pathology; AAS=Adult Attachment Scale; AHQ=Attachment History Questionnaire; CaMir=CaMir Q-sort.

3.6.3.2. Meta-Analysis: Parental care

Twenty-five studies were identified that measured perceived parental care (Amianto, 2011; Bonne et al., 2003; Bulik, Sullivan, Wade, & Kendler, 2000; Calam, Waller, Slade, & Newton, 1990; Canetti, Kanyas, Lerer, Latzer, & Bachar, 2008; Cardi et al., 2012; De Panfilis, Rabbaglio, Rossi, Zita, & Maggini, 2003; Deas, Power, Collin, Yellowlees, & Grierson, 2011; Di Pentima et al., 1998; Fassino, Amianto, Rocca, & Daga, 2010; Fujimori et al., 2011; Gomez, 1984; Guttman & Laporte, 2002; Kent & Clopton, 1992; Laporte & Guttman, 2007; Leung, Thomas, & Waller, 2000; Palmer, Oppenheimer, & Marshall, 1988; Rhodes & Kroger, 1992; Russell, Kopec-Schrader, Rey, & Beumont, 1992; Steiger, Van der Feen, Goldstein, & Leichner, 1989; Striegel-Moore et al., 2005; Swanson et al., 2010; Vandereycken & Perris, 1994; Wade, Gillespie, & Martin, 2007; Yamaguchi et al., 2000). Each study measured parental care using the Parental Bonding Instrument (PBI). The studies were included in the meta-analysis shown in the forest plot in Figure 2. People with ED reported lower levels of perceived parental care with a moderate ES 0.53 (95%CI: 0.41, 0.65, $p < .001$) relative to HC. This overall effect remained moderate .51 ($p < .001$) after adjusting using the meta-regression and there was no evidence of publication bias (Begg's test p=.080; Egger's test p=.413).

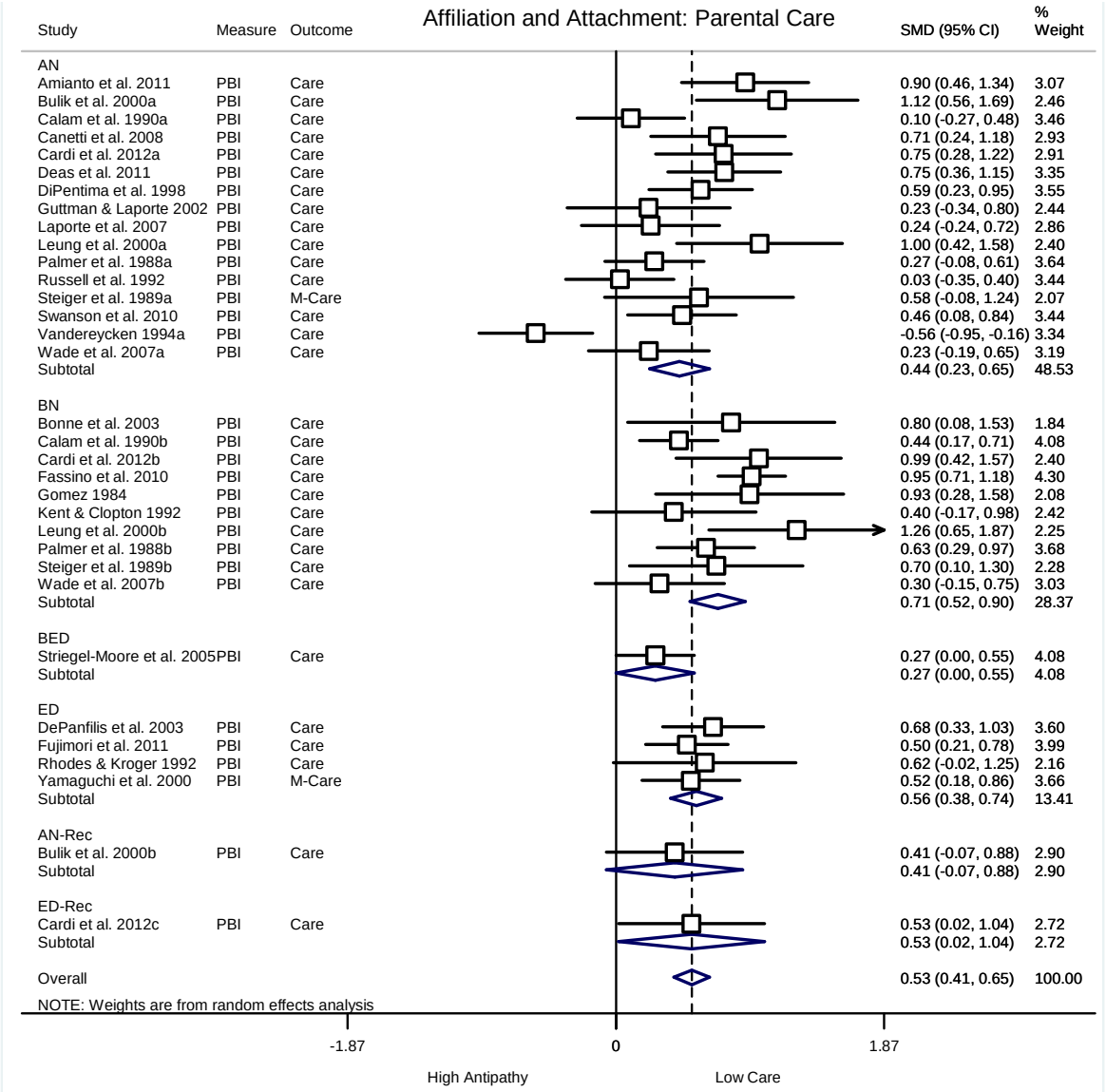

Figure 2. Forest plot for the meta-analysis of parental care by self-report in eating disorders. Abbreviation: PBI=Parental Bonding Instrument.

3.6.3.3. Meta-Analysis: Parental overprotection

The same twenty-six studies as in the prior analysis were included in the meta-analysis of perceived parental overprotection shown in Figure 3 (Amianto, 2011; Bonne et al., 2003; Bulik et al., 2000; Calam et al., 1990; Canetti et al., 2008; Cardi et al., 2012; De Panfilis et al., 2003; Deas et al., 2011; Di Pentima et al., 1998; Fassino et al., 2010; Fujimori et al., 2011; Gomez, 1984; Guttman & Laporte, 2002; Kent & Clopton, 1992; Laporte & Guttman, 2007; Leung et al., 2000; Palmer et al., 1988; Rhodes & Kroger, 1992; Russell et al., 1992; Steiger et al., 1989; Striegel-Moore et al., 2005; Swanson et al., 2010; Vandereycken & Perris, 1994; Wade et al., 2007; Yamaguchi et al., 2000). People with ED reported higher levels of overprotection with a small ES 0.33 (95%CI: 0.21, 0.45, $p < .001$) relative to HC. This overall effect remained small .29 ($p = .022$) following adjustments made to the overall effect by the meta-regression. We found evidence of publication bias (Begg's test p=.025; Egger's test p=.036). The trim and fill method estimated that twenty studies were missing from the analysis. The adjusted ES remained small .14 (95%CI: 0.01, 0.27, $p = .033$) after correcting for publication bias using this method.

3.6.3.4. Systematic Review: Affiliation and attachment

Studies which could not be included in the meta-analysis are discussed below. The results from the Adult Attachment Interview (AAI) showed that individuals with ED had less State of Mind (d=.14), coherence of transcript (d=2.37) and Probable Experience of Positive Attachment (d=1.34), but they had more Probable Experience of Negative Attachment (d=1.03) (Ward et al., 2001). People with ED were less likely to speak about interpersonal relationships, although the ES found was negligible (d=.07) (Doba, Nandrino, Lesne, Humez, & Pezard, 2008). In other self-reports of attachment style, people with ED were found to show an increase in dysfunctional attachment (d=.37) and separation anxiety (d=.58- d=.66) (Ward et al., 2000; Troisi et al., 2005). Those with ED showed lower levels of general attachment (d=.46 – d=1.12) (Cunha, Relvas, & Soares, 2009; Kenny & Hart, 1992). Individuals with ED showed a greater ability to distinguish attachment figures from other types of figures (d=.11) and better understood the provisions of attachment figures (d=.35) (Ward et al., 2000). The NIMH RDoC states that social anhedonia is an area of 'Affiliation and Attachment'. Research in this areas shows that individuals with ED had higher levels of social anhedonia (d=1.48-1.95) (Tchanturia, Davies, Harrison, et al., 2012).

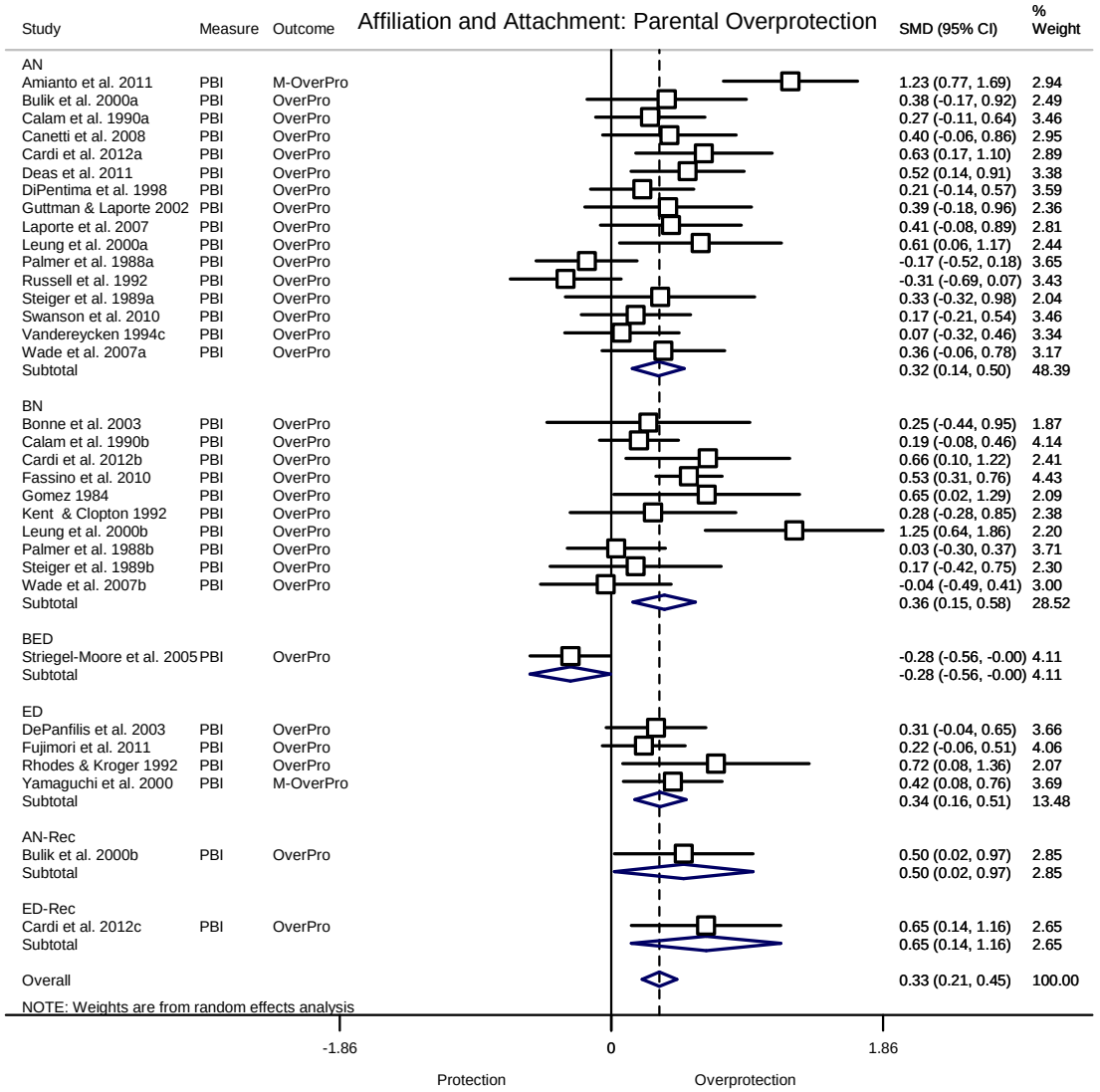

Figure 3. Forest plot for the meta-analysis of parental overprotection by self-report in eating disorders
Abbreviation: PBI=Parental Bonding Instrument.

3.6.4. Reception of facial communication

3.6.4.1. Meta-Analysis: Reception of facial communication

Seven studies were found for the area of Reception of facial communication studies (Kessler, Schwarze, Filipic, Traue, & von Wietersheim, 2006; Kucharska-Pietura et al., 2004; Legenbauer et al., 2008; Mendlewicz et al., 2005; Zonnevijlle-Bendek, Van Goozen, Cohen-Kettenis, Van Elburg, & Van Engeland, 2002; Zonnevylle-Bender, van Goozen, Cohen-Kettenis, & Herman van Engeland, 2004; Zonnevylle-Bender et al., 2004). Each study measured facial emotion recognition through experimental tasks. The studies are included in the forest plot shown in Figure 4. People with ED showed poor facial emotion recognition although the ES for this is small 0.26 (95%CI: 0.08, 0.45, p = .005). The overall effect became nonsignificant after adjusting using the meta-regression .44 (p = .26). There was no evidence of publication bias (Begg's test p=.386; Egger's test p=.506).

3.6.4.2. Systematic review: Reception of facial communication

Several studies investigated different responses to presentations of facial stimuli. People with AN were found to be faster at detecting happiness and sadness (d=.36) (Castro, Davies, Hale, Surguladze, & Tchanturia, 2010). People with ED made more errors when matching photographs of facial emotional expressions, AN (d=.53) and BN (.64) (Rozenstein et al., 2011). Variations of attentional paradigms showed that people with ED had a greater interference effect to angry faces, which ranged from small to large (d=0.10-d=1.02), and had a lower facilitation effect in response to happy (d=.04) and sad and angry faces (d=.25) (Godart et al., 2003; Goddard, Carral-Fernández, Denneny, Campbell, & Treasure, 2013; Harrison, Sullivan, et al., 2010; Harrison, Tchanturia, et al., 2010; Cserjesi et al., 2011).

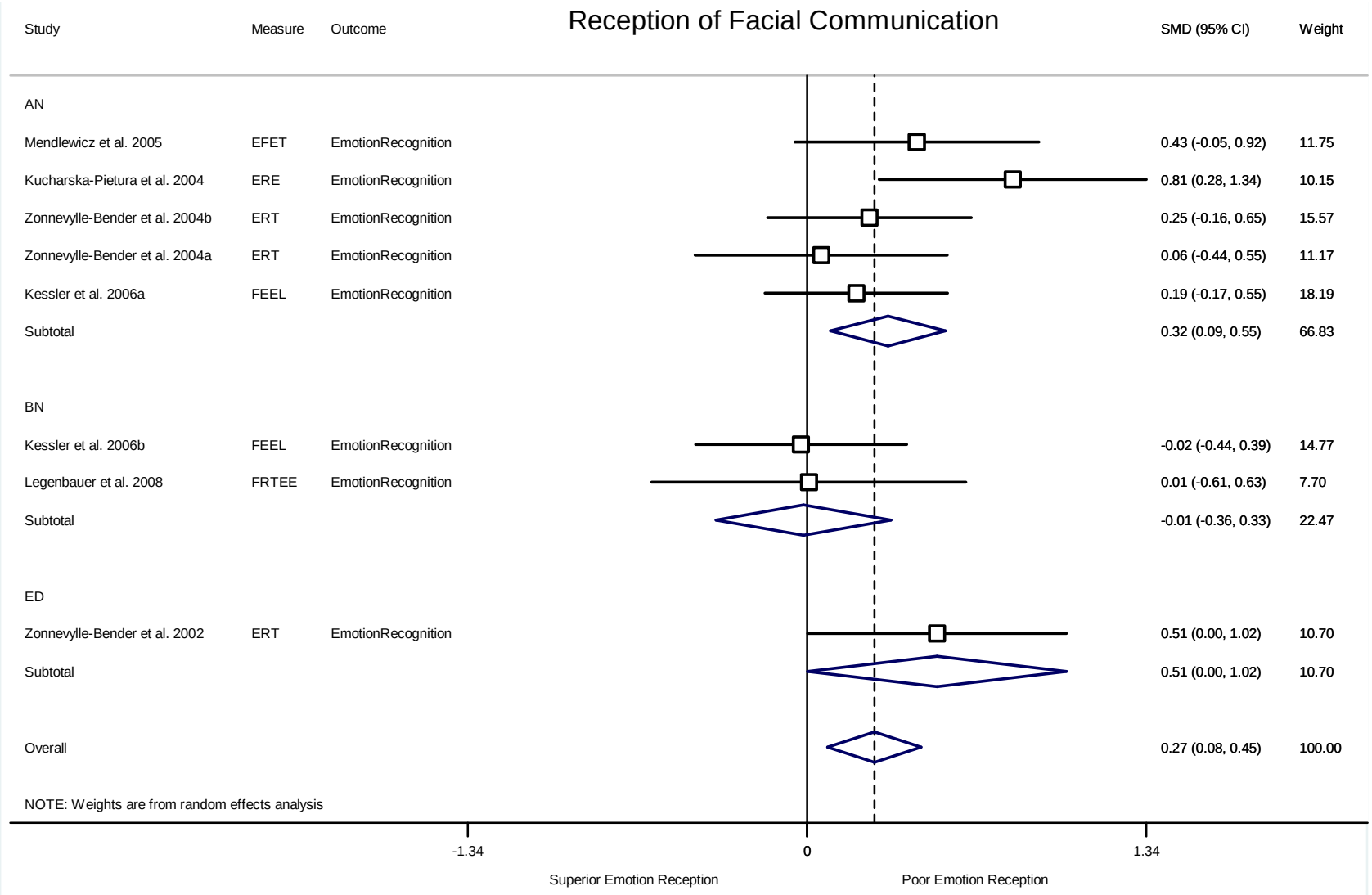

Figure 4. Forest plot for the meta-analysis for reception of emotion recognition measured by experimental tasks in eating disorders. Abbreviations: FEEL= Facially Expressed Emotion Labelling; ERE= Emotion Recognition Experiment; ERT=Emotion Recognition Test; FRTEE= Facial Recognition Task for Expressed Emotions.

3.6.5. Production of facial communication

3.6.5.1. Systematic review: Facial production

Adults (d=1.56) and adolescents (d=0.93) with AN appear to show low levels of production in response to emotional film clips (Davies, Schmidt, Stahl, & Tchanturia, 2011; Rhind et al., submitted). One study using facial recognition software showed that people with ED had fewer facial expressions while playing a video game (d=.16 - d=.55) (Claes et al., 2012).

3.6.5.2. Systematic review: Facial avoidance

Adults (d=1.68) and adolescents (d=.70) with AN appear to show more facial avoidance than controls in response to emotional film clips (Davies et al., 2011; Rhind et al., submitted).

3.6.6. Reception of non-facial communication

3.6.6.1. Systematic review: Reception of non-facial communication

Four studies which measured aspects of 'Reception of Non-Facial Communication' were identified and their findings are discussed below. In various tasks, people with ED appeared to be poorer at recognising emotion from voices (d=1.32) and affective pictures (d=0.84) (Kucharska-Pietura et al., 2004; Nandrino et al., 2012). They experienced a larger interference effect processing emotional words (d=.82) (Jones-Chesters, Monsell, & Cooper, 1998). Contradictory findings were reported in ratings of emotional response to emotional pictures. Individuals with AN and BN were found to have lower emotional ratings compared to HC in one study (d=.70; d=.36), while in another report individuals with AN had higher ratings compared to HC (d=0.50) (Joos, Cabrillac, Hartmann, Wirsching, & Zeeck, 2009; Nandrino et al., 2012).

3.6.7. Production of non-facial communication

3.6.7.1. Systematic review: Production of non-facial communication

Three studies were identified within the construct of 'Production of Non-Facial Communication'. Two of the three studies found were experimental, while the third contained a self-report measure. The findings from the two experimental studies showed that people with ED had less verbal emotional expression with a negligible ES (d=.08 - d=.12) and that mothers with ED expressed more strong controlling verbal behaviours (e.g. command/forbid) (d=.73) than gentle behaviours (prompt/guide/suggest) (d=.33) when interacting with their offspring (Davies, Swan, Schmidt, &

Tchanturia, 2012; Stein et al., 2001). The study which contained a self-report measure found that people with AN (d=.27) were less prone to crying than HC, while those with BN were more prone to crying (d=.23) (Mangweth et al., 1999).

3.6.8. Agency

3.6.8.1. Meta-Analysis: Agency

The definition of agency according to the RDoC project is "the ability to recognize one's self as the agent of one's actions and thoughts, including the recognition of one's own body/body parts"(as defined in the NIMH workshop: http://www.nimh.nih.gov/research-priorities/rdoc/rdoc-social-processes.pdf). The sense of agency refers to the ability to recognize oneself as the agent of a behaviour and, as a result, to the proprioceptive awareness that one's body corresponds to the agent itself (Jeannerod, 2003). Animacy on the other hand is the ability to perceive that another entity is an agent showing contingent behaviours.

Five studies measured the sense of agency using experimental tasks (Epstein et al., 2001; Eshkevari et al., 2012; Guardia, Cottencin, Thomas, Dodin, & Luyat, 2012; Keizer, Smeets, Dijkerman, van Elburg, & Postma, 2012; Papezova, Yamamotova, & Uher, 2005). The studies were included in the forest plot shown in Figure 5. People with ED have a lower sense of agency with a moderate ES 0.50 (95%CI: 0.36, 0.65, $p < .001$). The overall small effect becomes nonsignificant .39 (p=.264) after using the meta-regression. There was no evidence of publication bias (Begg's test p=.189; Egger's test p=.109).

3.6.8.2. Systematic review: Agency

In support of the findings from the meta-analysis, results from two self-report questionnaires and experimental tasks show that people with ED have an altered sense of agency. They have more symptoms of somatoform dissociation (d=.486– d=.942) (Papezova et al., 2005). Their sensory sensitivity (d=0.963-d=1.075) and pressure detection threshold (d=.334) differ from controls (Zucker et al., 2013; Keizer et al., 2012). Individuals with ED report anomalies in their sensory profile, they are more avoidant of sensation (d=1.007-d=1.086) and seek sensation less (d=0.254-d=0.317) (Zucker et al., 2013). Two studies measured interpretations of dynamic body dimensions in experimental tasks. People with ED showed higher 'actual' (d=.54 - d=.16) and 'felt' BMI (d=.39 - d=.88). Also people with ED reported that an 'ideal' BMI would be approximately 20 (d=.04 - d=.74) (Legenbauer et al., 2011; Vocks, Legenbauer, Ruddel, & Troje, 2007).

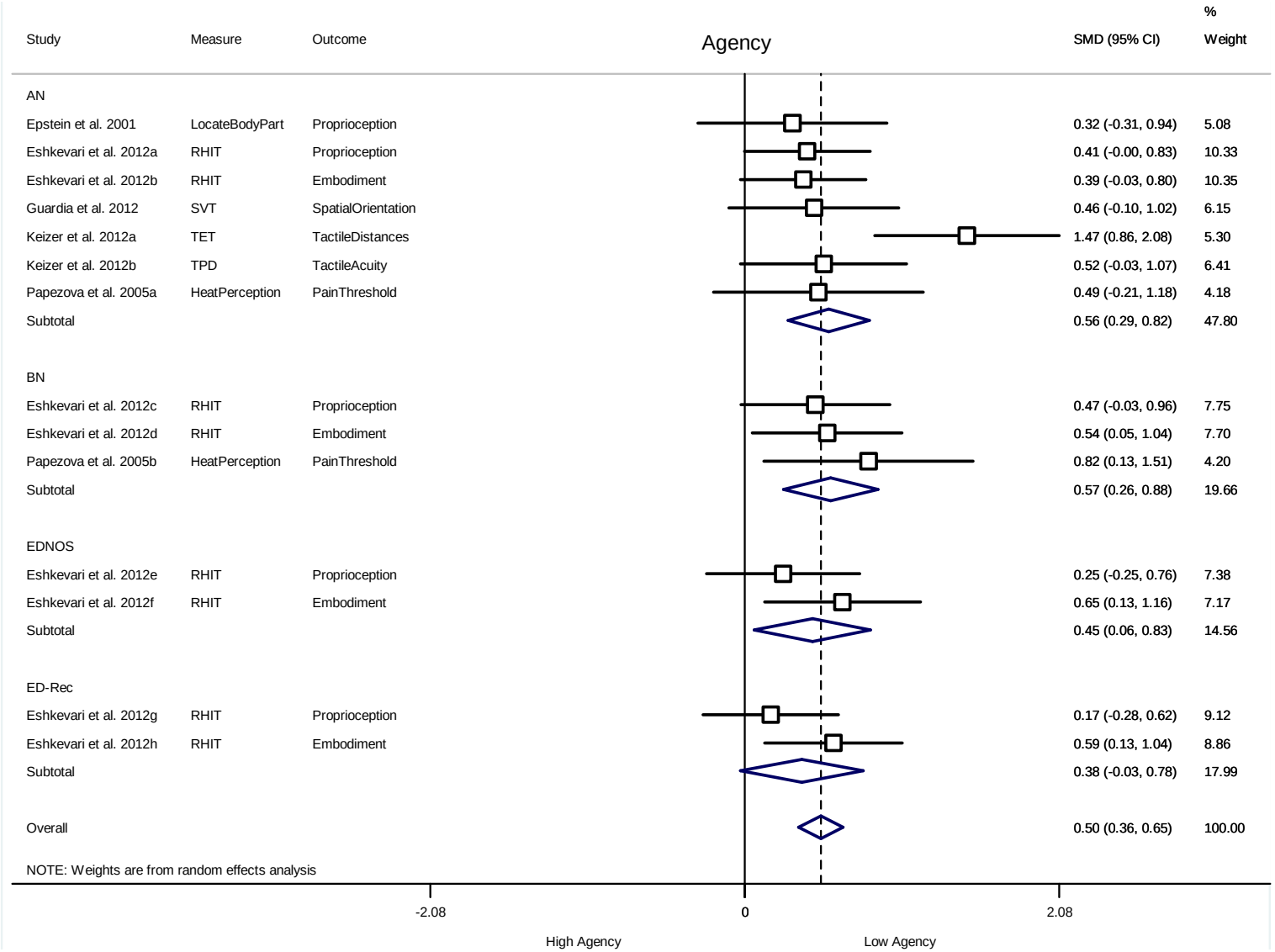

Figure 5. Forest plot for the meta-analysis for agency in eating disorders

Abbreviations: Locate Body Part=Proprioception Task; RHIT=Rubber Hand Illusion Task; SVT=Subjective Vertical Task; TET=Tactile Estimation Task; TPD=Two Point Discrimination; Heat Perception=Pain Threshold

3.6.9. Self-knowledge

3.6.9.1. Meta-Analysis: Self-evaluation

Thirty-one studies measured self-evaluation via self-report questionnaires (Bachner-Melman, Zohar, Ebstein, & Bachar, 2007; Bachner-Melman, Zohar, Ebstein, Elizur, & Constantini, 2006; Beato, Rodriguez Cano, & Belmonte, 2003; Berg et al., 2011; Blaase & Elklit, 2001; Blechert, Ansorge, Beckmann, & Tuschen-Caffier, 2011; Brytek-Matera, 2007; Ciccolo & Johnsson, 2002; Cockerham, Stopa, Bell, & Gregg, 2009; Daley, Jimerson, Heatherton, Metzger, & Wolfe, 2008; De Zwaan et al., 1994; Dykens & Gerrard, 1986; Geller, Cockell, Hewitt, Goldner, & Flett, 2000; Geller et al., 1998; Hilbert, Tuschen-Caffier, & Vogele, 2002; Jacobi, Paul, de Zwaan, Nutzinger, & Dahme, 2004; Kiezebrink, Campbell, Mann, & Blundell, 2009; Leung & Price, 2007; McFarlane, McCabe, Jarry, Olmsted, & Polivy, 2001; Mendelson, McLaren, Gauvin, & Steiger, 2002; Morrison et al., 2003; Napolitano, Head, Babyak, & Blumenthal, 2001; Paterson et al., 2011; Paterson, Power, Yellowlees, Park, & Taylor, 2007; Rosen & Ramirez, 1998; Sassaroli, Gallucci, & Maria Ruggiero, 2008; Senra, Sanchez-Cao, Seoane, & Leung, 2007; Telch & Stice, 1998; Vanderlinden et al., 2009; Wilksch & Wade, 2004; Williams et al., 1993). The studies were included in a meta-analysis and are presented in the forest plot in Figure 6. A single outlier was identified (McFarlane et al., 2001) and removed from the analysis. People with ED negatively evaluate themselves compared to HC, the overall ES was large 1.59 (95%CI: 1.38, 1.80, $p < .001$). The combined ES including the outlier was still large 1.69 (95%CI: 1.46, 1.93, $p < .001$). The overall effect after removing the outlier became larger 2.27 ($p < .001$) after adjusting with the meta-regression. Publication bias was found (Begg's test p=.007; Egger's test p=.001). The trim and fill method estimated that eleven studies were missing from the analysis. The adjusted ES remained large 1.22 (95%CI: 0.99, 1.45, $p < .001$) after correcting for suspected publication bias.

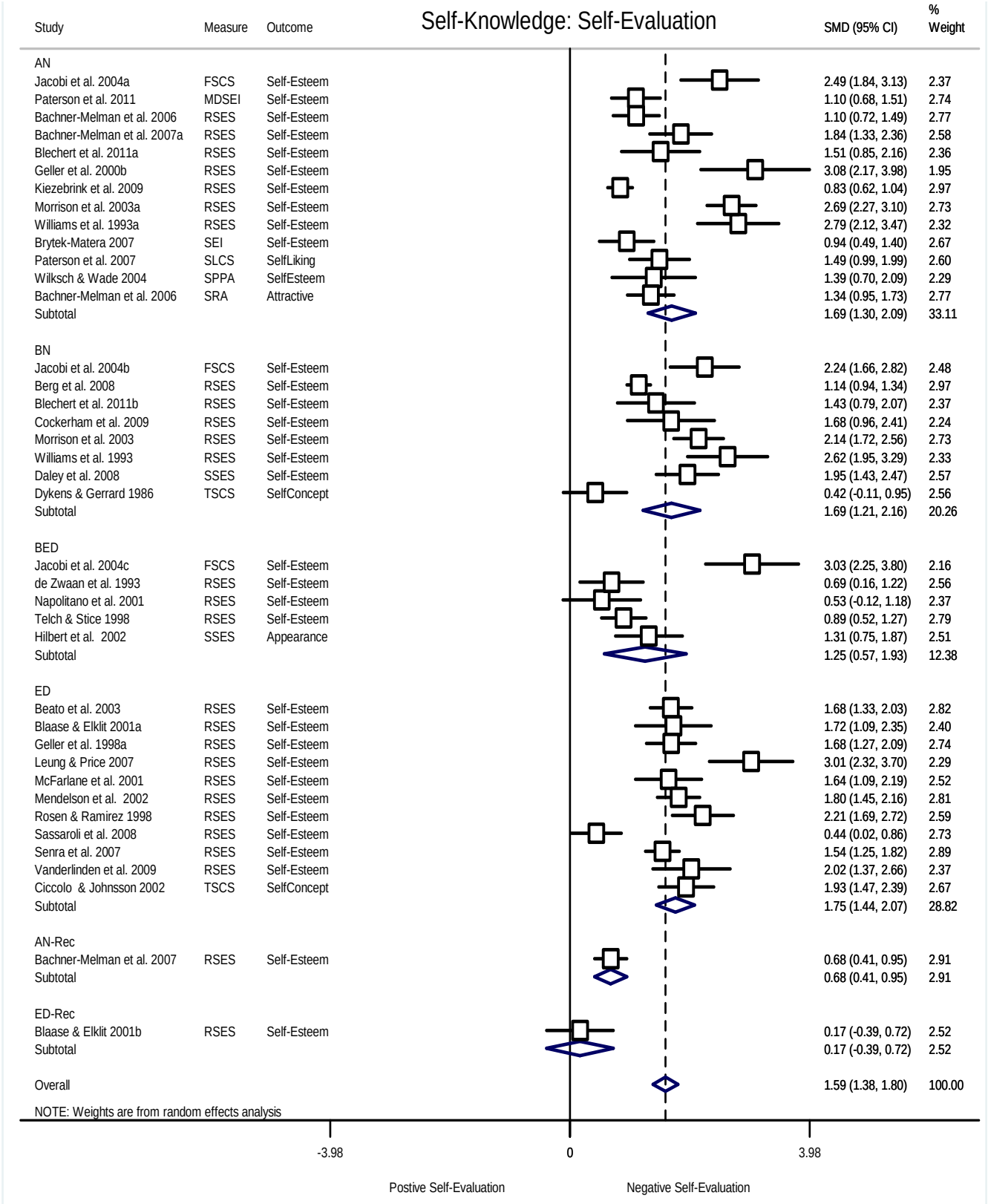

Figure 6. Forest plot for the meta-analysis for self-evaluation in eating disorders

Abbreviations: RSES=Rosenberg Self-Esteem Scale; SRA=Self-Rated Attractiveness; SEI=Self-Esteem Inventory; FSCS=Frankfurt Self-Concept Scales; SLCS=Self-Liking/Competence Scale; MDSEI=Multi-Dimensional Self-Esteem Inventory; SPPA=Self-Perception Profile for Adolescents; TSCS=Tennessee Self-Concept Scale; SSES=State Self-Esteem Scale

3.6.9.2. Systematic-review: Self-evaluation

In support of the findings in the meta-analysis, people with ED had more self-monitoring thoughts (d=.583) and spent longer when making self-referent judgements about emotional words in experimental tasks (d=.804) (Zotter & Crowther, 1991; Jänsch, Harmer, & Cooper, 2009). Seven studies measured self-evaluation through self-report questionnaires. Individuals with ED had greater negative self-esteem (d=2.589), self-consciousness (d=1.56; d=1.69) and meta-cognitions (d=1.266) (Joiner, Schmidt, & Wonderlich, 1997; Forbush & Watson, 2006; Striegel-Moore, Silberstein, & Rodin, 1993; Cooper, Grocutt, Deepak, & Bailey, 2007). People with ED had a low perception of self-competence (d=.746), they engaged in more self-silencing behaviours (d=.959) with higher expression and anger toward self (d=.202) (Grisset & Norvell, 1992; Hambrook et al., 2011; Brytek-Matera, 2007). People with ED were similar to controls in their view of self-consciousness, in terms of both private (attend to inner thoughts and feelings) and public self (awareness of self as a social object) (d<.01).

3.6.9.3. Meta-Analysis: Alexithymia

Twenty-nine studies were identified in the area of alexithymia (Adenzato, Todisco, & Ardito, 2012; Beadle, Paradiso, Salerno, & McCormick, 2013; Bourke, Taylor, Parker, & Bagby, 1992; Cochrane, Brewerton, Wilson, & Hodges, 1993; de Groot, Rodin, & Olmsted, 1995; De Panfilis et al., 2003; de Zwaan et al., 1995; de Zwaan, Biener, Bach, Wiesnagrotzki, & Stacher, 1996; Deborde et al., 2008; Eizaguirre, de Cabezon, Alda, Olariaga, & Juaniz, 2004; Jimerson, Wolfe, Franko, Covino, & Sifneos, 1994; Kessler et al., 2006; Kessler et al., 2013; Kuhnpast, Gramann, & Pollatos, 2012; Miyake, Onoda, Shirao, Okamoto, & Yamawaki, 2012; Nandrino et al., 2012; Nandrino, Doba, Lesne, Christophe, & Pezard, 2006; Parling, Mortazavi, & Ghaderi, 2010; Pinaquy, Chabrol, Simon, Louvet, & Barbe, 2003; Pollatos et al., 2008; Schmidt, Jiwany, & Treasure, 1993; Schulte-Rüther, Mainz, Fink, Herpertz-Dahlmann, & Konrad, 2012; Speranza et al., 2005; Taylor, Parker, Bagby, & Bourke, 1996; Tchanturia, Davies, Harrison, et al., 2012; Torres et al., 2011; Troop, Schmidt, & Treasure, 1995; Zeeck, Stelzer, Linster, Joos, & Hartmann, 2011; Zonnevijlle-Bendek et al., 2002; Zonnevylle-Bender et al., 2004). The studies are presented in the forest plot in Figure 7. People with ED have high levels of alexithymia with a large ES 1.31 (95%CI: 1.15, 1.46, p < .001). This effect became nonsignificant after adjusting using the meta-regression .66 (p = .50). Publication bias was found (Begg's test p=.002; Egger's test p<.001) and fourteen studies were estimated by the trim and fill method to be missing from the analysis. The adjusted ES remained large .99 (95%CI: 0.82, 1.15, p < .001) after correcting for publication bias.

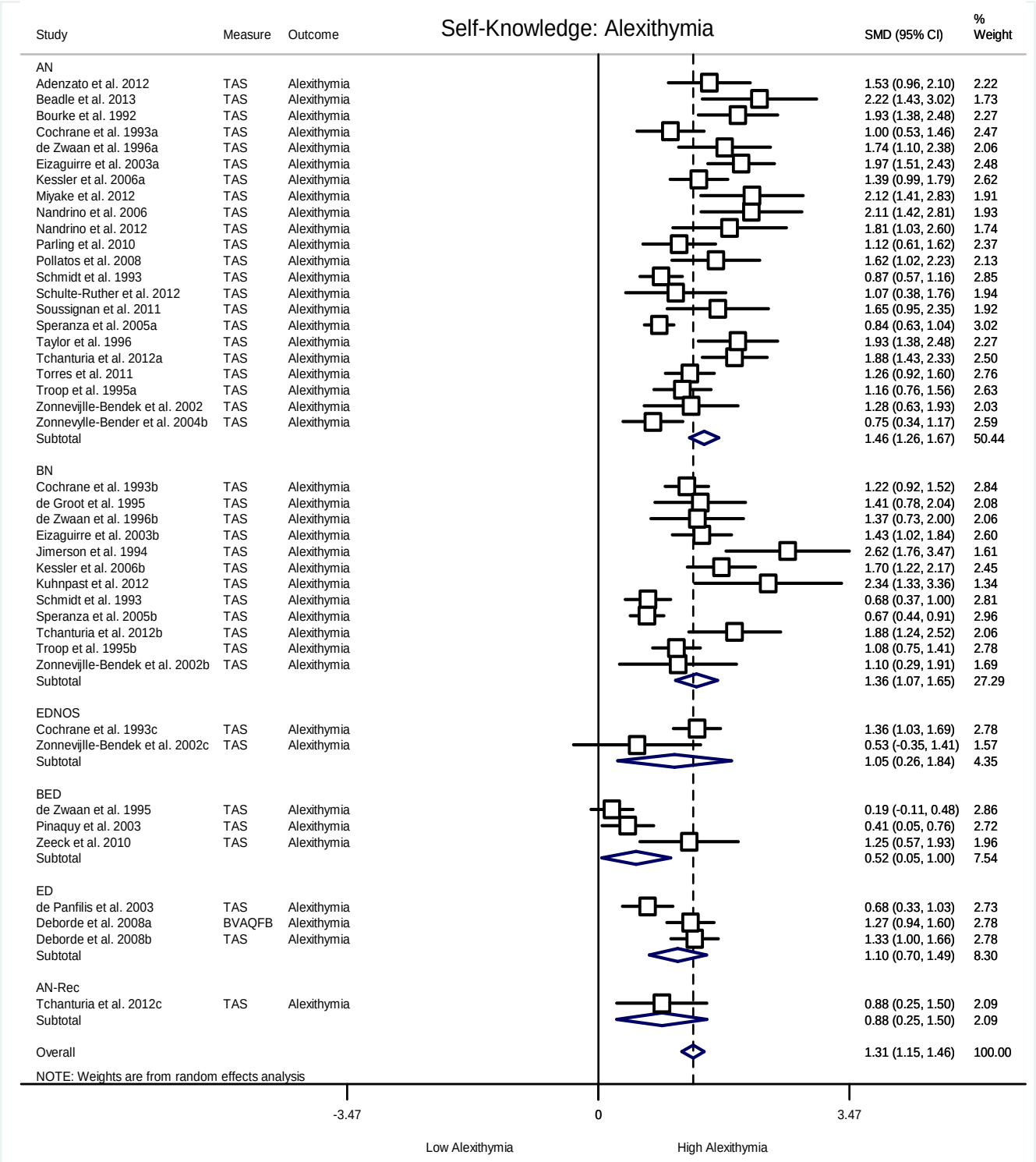

Figure 7. Forest plot for the meta-analysis for alexithymia in eating disorders

Abbreviations: TAS=Toronto Alexithymia Scale; BVAQ=Bermond-Vorst Alexithymia Questionnaire.

3.6.9.4. Systematic review: Alexithymia

In support of the meta-analysis people with ED have lower levels of emotional awareness according to self-report questionnaires (d=0.082-d=1.097) (Bydlowski et al., 2005; Oldershaw, Hambrook, Tchanturia, Treasure, & Schmidt, 2010; Parling et al., 2010).

3.6.10. Understanding mental states

3.6.10.1. Meta-Analysis: Understanding mental states

Twelve studies measured 'Understanding Mental States' through experimental tasks (Adenzato et al., 2012; Gillberg et al., 2010; Goddard & Treasure, 2013; Goddard et al., 2013; Harrison, Tchanturia, et al., 2010; Harrison et al., 2009; Kenyon et al., 2012; Medina-Pradas, Navarro, Alvarez-Moya, Grau, & Obiols, 2012; Oldershaw et al., 2010; Renwick, Dejong, et al., 2013; Russell, Schmidt, Doherty, Young, & Tchanturia, 2009; Tchanturia et al., 2004). The studies were included in the forest plot shown in Figure 8. Individuals with ED showed poorer perception of the mental states of others relative to HC. The overall ES was moderate at .44 (95%CI: 0.27, 0.62, $p < .001$) and this became larger 1.07 ($p = .001$) after adjusting using the meta-regression. Publication bias was found (Begg's test p=.002; Egger's test p=.001. The trim and fill method estimated that four studies were missing from the analysis. The adjusted ES remained small .32 (95%CI: 0.13, 0.50, $p = .001$) after correcting for this bias.

3.6.10.2. Systematic review: Understanding mental states

Eight studies measured understanding mental states through self-report instruments. People with ED reported more perspective taking (d=1.22), but reported less empathy (d=.03) (Rupp & Jurkovic, 1996; Hambrook, Tchanturia, Schmidt, Russell, & Treasure, 2008). Individuals with ED had poorer social skills and more psychological disturbance (d=.41 - d=.26) (Duchesne et al., 2012; Guttman & Laporte, 2000; Schulte-Rüther et al., 2012). People with ED showed difficulties in making attributions, on a measure of ability to make general attributions, they scored lower than HC (d=.56), they were more likely to attribute negative events to others rather than to situations (d=.14) and were poorer at making attributions concerning the causality of social relationships (i.e. the understanding of the degree to which psychological processes are involved in the development of thoughts, emotions and actions) (d=1.02 - d=.1.22) (Wittorf et al., 2012; Morrison, Waller, & Lawson, 2006; Morrison et al., 2006; Rothschild-Yakar, Levy-Shiff, Fridman-Balaban, Gur, & Stein, 2010; Rothschild-Yakar, Eviatar, Shamia, & Gur, 2011).

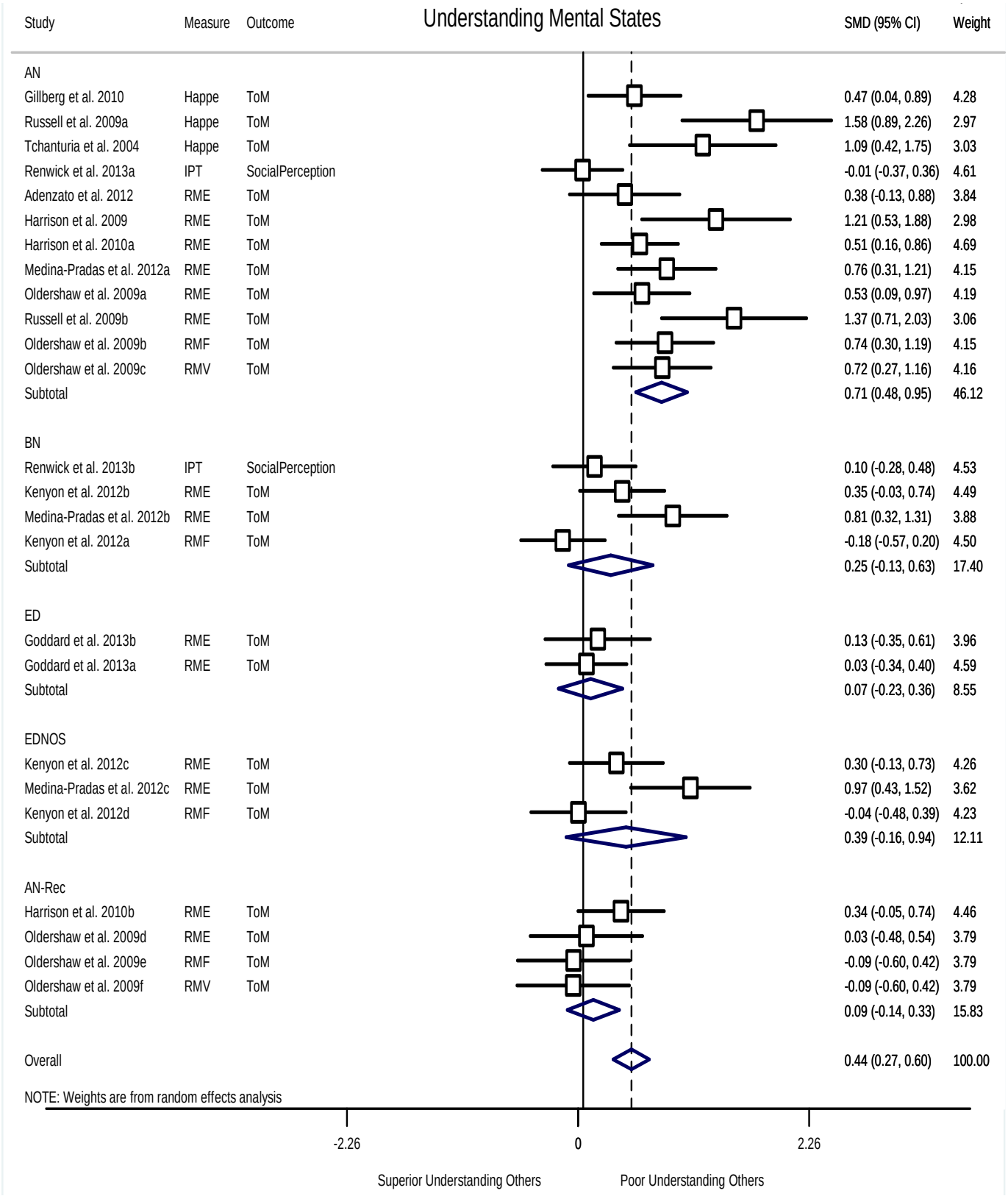

Figure 8. Forest plot for the meta-analysis for understanding mental states in eating disorders Abbreviations: RME=Reading the Mind in the Eyes; Happe=Happe Task; RMF=Reading the Mind in the Films; RMV=Reading the Mind in the Voice; IPT=Interpersonal Perception Task.

3.6.11. Social dominance

3.6.11.1. Meta-Analysis: Social dominance

Eight studies were included in the meta-analysis of social dominance (Cardi et al., 2014; Carter, Kelly, & Norwood, 2012; Doran & Lewis, 2012; Hartmann, Zeeck, & Barrett, 2010; Masheb, Grilo, & Brondolo, 1999; Swan & Andrews, 2003; Troop et al., 1995; Waller, Ohanian, Meyer, & Osman, 2000). These studies measured social dominance through self-report questionnaires. They are presented in the forest plot shown in Figure 9. People with ED reported a greater sense of social inferiority than controls with a large ES at 1.22 (95%CI: 0.87, 1.56, $p < .001$) and this overall effect remained large 1.08 ($p = .006$) after adjusting using the meta-regression. There was no evidence of publication bias (Begg's test p=.381; Egger's test p=.089).

3.6.11.2. Systematic review: Social dominance

Confirming the result from the meta-analysis, a single study using self-report showed that individuals with ED engaged in higher levels of social comparison than controls (d=1.50 - d=4.98) (Troop, Allan, Treasure, & Katzman, 2003).

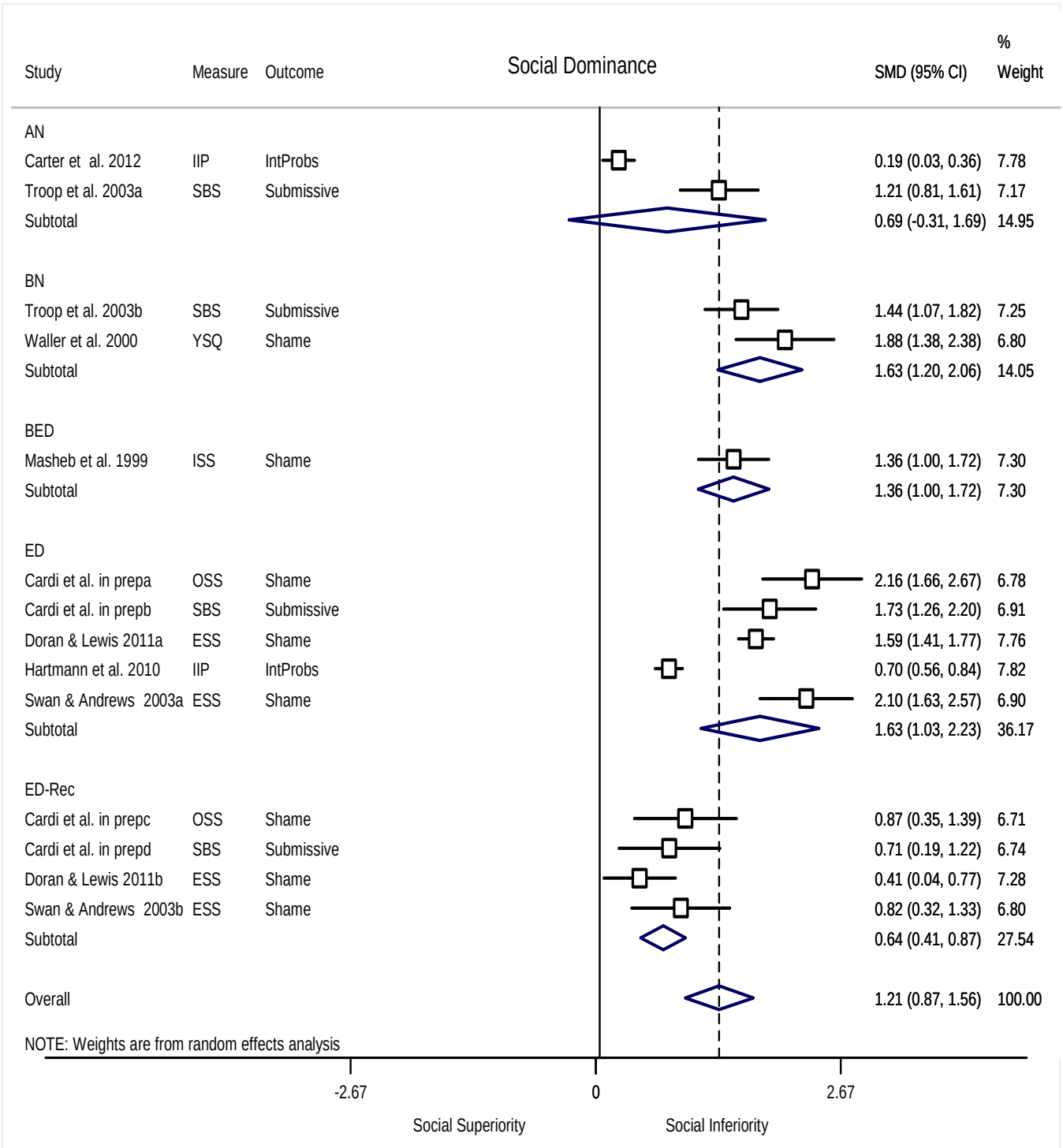

Figure 9. Forest plot for the meta-analysis for social dominance in eating disorders

Abbreviations: IIP=Inventory of Interpersonal Problems; SBS=Submissive Behaviour Scale; YSQ=Young Schema Questionnaire; ISS=Internal Shame Scale; OSS=Other as Shamer Scale; ESS=Experience of Shame Scale.

3.7. Discussion

The aim of the current study was to synthesise the literature on the constructs/sub-constructs within the NIMH RDoC domain of 'Systems for Social processes' in people with ED. A systematic review and meta-analysis was conducted. The overall conclusion drawn from the review was that people with ED exhibit aspects of psychopathology across the range of subconstructs within social processes. Problems in social functioning were noted in (a) 'Affiliation and Attachment', with insecure attachment (d=1.31), perceived low parental care (d=.51) and high parental overprotection (d=0.29); (b) 'Social Communication', with poor facial emotion recognition (d=.44); (c) 'Perception and Understanding of Self', with low agency (d=.39), negative self-evaluation (d=2.27) and high alexithymia (d=.66); (d) 'Perception and Understanding of Others' with difficulties understanding the mental states of others (d=1.07); (e) 'Social Dominance' with social inferiority (d=1.08). Studies discussed in the systematic review lend further support for these findings.

The main disturbances in the social processes in ED relate to feeling insecure in relationships with self and others, reduced non-verbal communication, avoidance of communication, problems in identifying, understanding, and verbalizing emotions, in self and others negative self-esteem, and increased social inferiority. The social disturbance of persons with ED is persistent and is found across a range of social capabilities. Social disturbances of patients with ED encompass areas which are also problematic in other forms of psychiatric disorders. Maladaptive social relations in adolescence and young adulthood are understood to be among the most important predictors of an unfavourable outcome (Lowe et al., 2001; Strober, Freeman, & Morrell, 1997).

3.8. Limitations and disadvantages

The limitations of this study should be addressed. Firstly, there was little information available for the subdomains of 'Reception of non-facial communication', 'Production of non-facial communication', 'Animacy' and 'Action perception'. Secondly, it was problematic to ascertain the quality of the studies included in the review. From visual inspection of the forest plot, the distribution of the weights of each study is similar and no single study appears to account for a large proportion of the ES. Removing the outlier from the analysis of 'Self-Evaluation' reduced the disproportionate effect this study contributed to the analysis. Thirdly, the data were synthesised from different instruments which measured the construct/subconstruct, which increased the likelihood of heterogeneity in the analysis. We attempted to adjust for this variation through meta-regression and by using the standardised mean coefficient. Additionally the meta-analysis could have been confounded by publication bias and replication. The standard *trim and fill* method was

performed to search for publication bias and samples overlapping with published data in other articles were excluded.

There are a number of disadvantages to the review. Firstly, many studies use self-report rather than behavioural measures and may be subject to response bias. Secondly, it is unclear how accurately the outcomes measured mapped onto the constructs. It has been suggested that attachment self-report instruments might measure personality traits rather than attachment behaviour with anxiety related to neuroticism and avoidance negatively related to extroversion (Crawford et al., 2006; Roisman et al., 2007). Thirdly, the majority of the studies identified investigated participants with a current diagnosis of AN and there were fewer studies available in BED. It is important for further studies to occur in samples of BN and BED to examine whether these are transdiagnostic traits. Most studies included participants who were in the ill state, therefore it would also be of interest to have more studies in recovered participants because of the use of this paradigm as an approximate means of examining whether these phenomena might be related to the effects of starvation on the brain.

In light of the limitations and disadvantages highlighted above any further discussion of these results must be circumspect. There are some interesting trends within the meta-analysis that might be of interest for further research, such as the finding that the trait of alexithymia does not appear to be as strong in people with BED.

3.9. Clinical Implications

The findings from the review support the inclusion of social factors in explanatory models both as causal and maintaining features (Schmidt & Treasure, 2006; Treasure et al., 2012; Treasure & Schmidt, 2013). The mechanism by which these problems contribute to the maintenance of the disorder remains unclear. Interventions which target problematic aspects of social processing may be of particular benefit or enhance existing treatments. For instance oxytocin might be used to improve the therapeutic alliance in forms of ED in which this social processing system is perturbed (Meyer-Lindenberg, Domes, Kirsch, & Heinrichs, 2011). There is potential to improve the functioning of these circuits by using forms of brain training to encourage plastic changes in these circuits, such as attentional bias modification (Renwick, Campbell, & Schmidt, 2013). It is important to involve partners (Bulik, Baucom, Kirby, & Pisetsky, 2011) and families (Goddard et al., 2011) in the treatment of ED.

3.10. Conclusions

The review presented based on the RDoC 'Systems for Social processes' suggests that people with ED exhibit aspects of psychopathology across the range of subconstructs within this domain. However not all subconstructs have been examined. Problems were most apparent in the domains of insecure attachment, alexithymia, lower facial communication, negative self-evaluation, and perceived social inferiority. These may be accentuated in the acute state of the illness perhaps as a consequence of starvation.

Chapter 4

Self-concept in Anorexia Nervosa

4.1. Self-concept: Implicit and explicit processing

Self-schemas are stable structures that characterise a person's thoughts, feelings and experiences about the self in any aspect (Markus & Sentis, 1982). It has been suggested that people are able to hold both explicit self-beliefs, which require expenditure of mental effort, and also implicit self-associations, which are held outside of conscious awareness and act automatically without awareness (Frith & Frith, 2008). While implicit and explicit measures investigate the same underlying behaviour, there are several explanations to suggest that these systems are distinct and are not always congruent (e.g. motivation; McClelland, 1985). A recent dual system account of the phenomenon proposes that implicit and explicit systems operate in parallel with one another and interact ('Reflective-Impulsive model'; Strack & Deutsch, 2004).

Typically implicit self-concept is measured using either the Implicit Association Task (IAT; Greenwald et al., 1998) or the Automatic Evaluation Task (AET; Fazio et al. 1995). These tasks examine automatic associations between 'self' and 'other' and are based on reaction times (RT). It is thought to be advantageous to measure implicit processing, as responses are likely to be relatively free from deliberate control (Fazio & Olson, 2003) and elaborate or reflective forms of processing (Roefs, Huijding, Smulders, MacLeod, de Jong, Wiers & Jansen, 2011).

4.2. Self-concept in eating disorders

It has been proposed that disturbances in identity development and a tendency to be overly self-critical are related to the psychopathology of AN (Stein & Corte, 2007; Longe et al., 2010). A negative self-concept has been linked with the maintenance of the disorder (Stein, 1996). Numerous studies have shown that people with ED have alterations in self-concept at both implicit and explicit levels. At the explicit level, people with ED have a more negative self-concept than controls with a large effect size (low self-esteem: d=2.27) as presented in the meta-analysis of self-report questionnaires in Chapter 3. They tend to be overly self-critical as assessed by a self-report questionnaire (Lehman & Rodin, 1989). Individuals with ED have lower levels of implicit positive self-evaluation as assessed by the IAT (Cardi et al., 2014).

People with ED show a strong interference effect when confronted with affective words, especially those which are negative. In variants of the Stroop task assessing implicit processing, people with ED

took longer to respond when confronted with words which related to negative affect (e.g. shame) (Stormark & Torkildsen, 2004), abuse (e.g. harm) (Waller & Ruddock, 1995) or were disorder relevant (e.g. depression) (Jones-Chesters, Monsell, & Cooper, 1998). In a visual probe detection task exploring implicit functioning, people with ED were vigilant to negative emotional words (e.g. angry). Those with AN were more vigilant to positive emotional words (e.g. happy) than individuals with BN were (Rieger et al., 1998). People with AN have been reported to show alterations in their implicit processing of disorder relevant stimuli (e.g. Jacoby's white noise task; Johansson, Ghaderi, Hallgren & Andersson, 2008; Implicit Relational Assessment Procedure; IRAP; Parling, Cernvall, Stewart, Barnes-Holmes & Ghaderi, 2012; Lexical Decision Task; LDT; Smith, Joiner & Dodd, 2014).

Alterations in self-concept could be related to perfectionism, which has also been implicated in the psychopathology of ED (Bulik et al., 2003). At an explicit level people with AN have high self-oriented perfectionism (Castro-Fornieles et al., 2007), self-imposed standards (Lampard, Byrne, McLean, & Fursland, 2012) and are highly concerned about making mistakes (Sassaroli, Gallucci, & Ruggiero, 2008). Perfectionism has been reported to be associated with self-competence at an explicit level in AN (Surgenor, Maguire, Russell, & Touyz, 2007). For example people with AN explicitly overrated their perceived competency deficits and underestimated their abilities (Bers & Quinlan, 1992).

4.3. Behavioural inhibition and social support

Self-views may influence behavioural inhibition and as well as ability to maintain relationships. People with AN are sensitive to punishment and have a low reward reactivity (Harrison, Treasure, & Smillie, 2011). They have anhedonia (Tchanturia, Davies, Harrison, et al., 2012) and a superior ability to delay reward (Steinglass et al., 2012). It is uncertain whether behavioural inhibition is related to one's self-beliefs. Earlier research shows that low social support is a risk factor for AN (Kim et al., 2010) and people with AN have less emotional and practical support compared to controls (Tiller et al., 1997). People with AN have been found to make unfavourable social comparisons (Cardi et al., 2014). A recent moderator analysis showed that self-criticism predicted an increase in stress and a decrease in interpersonal support in a non-clinical sample (Priel & Shahar, 2000).

4.4. Aim

The aim of this study is to examine implicit self-concept in relation to behavioural inhibition and social support in women with AN.

4.5. Hypotheses

1. Our first hypothesis is that women with AN would be more self-critical than healthy women as measured by the Implicit Self-Criticism Task (Perkins, personal communication), since previous studies reported that people with ED were overly self-critical (e.g. Lehman and Rodin, 1989; Bers & Quinlan, 1992). We anticipated that there would be a correlation between self-criticism and social support, as people with ED have been reported to make unfavourable social comparisons (Cardi et al., 2014).
2. Our second hypothesis is that people with AN would preferentially process negative affective self-descriptors, in contrast to negative general or positive affective self-descriptors compared to healthy women as measured by the LDT (Krahe, Harrison, Paloyelis & Fotopoulou, personal communication), as people with ED show lower levels of implicit positive self-evaluation (Cardi et al., 2014). We expected that behavioural inhibition would correlate with attitudes towards the self. Earlier work showed that people with AN are sensitive to punishment and have a low reward reactivity (Harrison, Treasure, & Smillie, 2011).

4.6. Methods and materials

4.6.1. Participants

Thirty-three women with AN and thirty-eight healthy women participated. Participants were recruited through advertisements from the South London and Maudsley (SLaM) National Health Service Foundation Trust Eating Disorder Inpatient Services, the Institute of Psychiatry's Section of ED volunteer database and the b-eat (Beating Eating Disorders) website and an e-mail circular sent out to the staff and students at King's College London (KCL). A DSM diagnosis of AN was obtained from a clinician or using the Structured Clinical Interview for DSM-IV Extended Module H (American Psychiatric Association, 1994). A tailored version of the Structured Clinical Interview for DSM Disorders was administered to screen for current or past mental health disorder in HC (First, Gibbon, Spitzer, & Williams, 1996). Inclusion criteria were females between the ages of 16-65 years old, fluent in English, with normal visual acuity and no motor impairment. Three HC were excluded for a past psychiatric disorder, receiving hormone replacement therapy or having a BMI over 35. The study received ethical approval (REC: 12/LO/1870) and all participants provided written informed consent.

4.6.2. Materials and measures

4.6.2.1. Self-report questionnaires

Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994)

The EDE-Q is a 36-item self-report measure of ED attitudes over the past 28 days. Items are scored using a 7-point, forced-choice, rating scheme. Four subscales (EDEQ-SC: shape concern; EDEQ-WC: weight concern; EDEQ-EC: eating concern; EDEQ-R: restraint) and a global score are calculated, with scores above 4 considered within the clinical range (Mond, Hay, Rodgers & Owen, 2006; Carter, Stewart & Fairburn, 2001). The EDE-Q has high internal consistency and good test-retest reliability (Luce & Crowther, 1999).

Depression Anxiety Stress Scales 21 (DASS) (Lovibond & Lovibond, 1995)

The DASS-21 is a 21-item self-report measure which assesses symptoms of depression (DASS-D), anxiety (DASS-A) and stress (DASS-S) during the past week. Items are scored on a 4-point, forced-choice, rating scheme. Three subscales are calculated. Higher scores represent a greater experience of symptoms (Lovibond & Lovibond, 1995). The DASS-21 has good construct validity (Henry & Crawford, 2005).

Behavioural Inhibition System and Behavioural Approach System (BIS/BAS) (Carver & White, 1994)

The BIS/BAS is a 24-item self-report measure of personality dimensions, which assesses sensitivity of the aversive and appetitive motivational systems ((BAS Drive (BAS-D), BAS fun seeking (BAS-FS), and BAS reward responsiveness (BAS-RR)). Higher scores represent a greater sensitivity in either system. The BIS/BAS has good internal reliability and reasonable alpha reliability (Carver & White, 1994).

Oslo Social Support (OSS) Scale (Meltzer, 2005)

The OSS is a 3-item self-report measure of general social support from close confidants, other people and neighbours. The sum of these items is interpreted as: poor support 3-8; moderate support 9-11; strong support 12-14 (Boen, Dalgard, & Bjertness, 2012).

4.6.2.2. Computerised Tasks

Implicit self-criticism task (Perkins, personal communication)

This is a yet to be validated computerised version of the Impressions of Success and Failure task (Nuttin & Greenwald, 1968). Participants are asked to read a brief about the task before beginning.

The brief informs participants that their visual perceptual ability is under examination during the task and also their analytical ability. The task instructions advise participants to make quick and accurate decisions about the properties of two images of geometric shapes based on predefined criteria (e.g. 'which image contains the largest surface area?') and then to answer questions about their performance. There are 5 types of tests in the task, each with the same format. There are nine trials in each test. The geometric shapes are presented for 5000ms. Participants make their decision by using the mouse to select one image.

The Implicit self-criticism task has been termed the "Fake IQ test" (Perkins, personal communication). The instructions inform participants that their visual perceptual and analytical ability are under examination, when in reality participant's performance on the task is not measured and self-criticism is indirectly assessed instead. At the end of each of the five tests participants : a) estimate their number of correct responses; b) indicate whether their performance was better or worse than others on the task; c) indicate whether they are satisfied with their performance. Scores from the three items are summed for a total score of self-criticism. Higher scores reflect higher self-criticism. The software for the Implicit self-criticism task was programmed in C++, by Psyal, Croydon, UK.

Lexical Decision Task (LDT) (Krahe, Harrison, Paloyelis & Fotopoulou, personal communication)

Response times and error rates were measured in response to a standard lexical decision procedure (e.g. Bradley, Mogg & Williams, 1995; Clark, Teasdale, Broadbent & Martin, 1983; Macleod & Mathews, 1991) involving positive, neutral, negative, negative general and pseudowords. In this task participants were instructed to decide whether they had been presented with a 'word' or a 'non-word'. Each trial began by presenting a fixation cross for 200ms, followed by a string of letters which were shown in the centre of the screen for 1500ms. Participants made their decision by using two keys ('z' or 'm') on the keyboard. There was a total of 120 trials, 60 trials contained 'non-words' (e.g. athists) and 15 trials of four 'word' categories included: 'neutral' (e.g. parked); 'negative general' (e.g. stolen); 'negative affective' (e.g. lonely) and 'positive affective' (e.g. embraced). The words were matched for length and frequency with which they occur in the English language. RT for valid trials and percentage of error was collected. Lower RT scores (i.e. faster) can be interpreted as meaning a greater implicit bias for that word group. RT scores lower than 250ms were considered as a premature response and were not logged. The category of 'nonwords' was not included in the analysis presented in this paper. This software was programmed in Real Basic and was run on Windows version XP.

Figure 10. Example of trials from the Self-Criticism Task and the Lexical Decision Task.

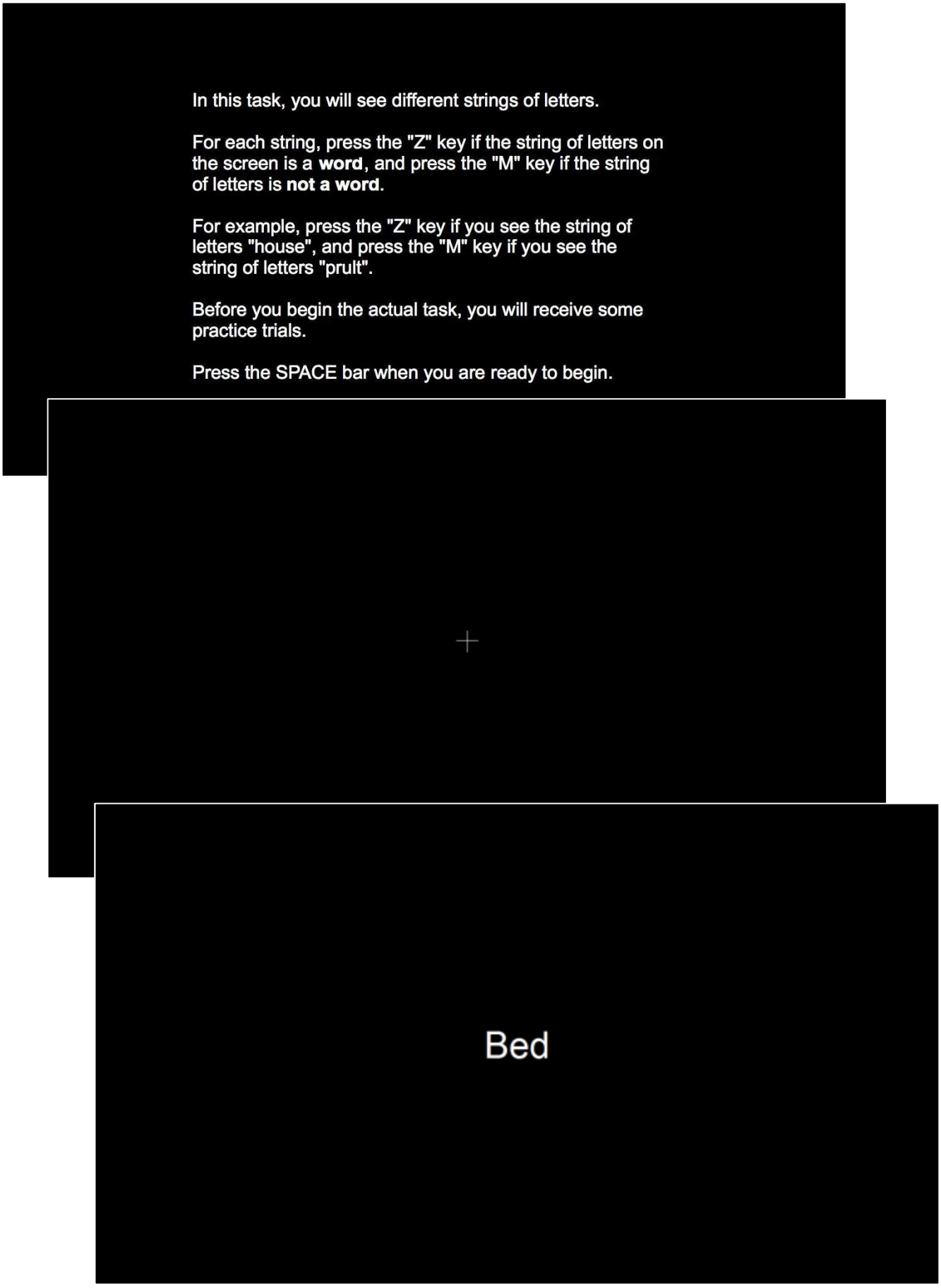

Figure 11. Example of trials from the Self-Criticism Task and the Lexical Decision Task.

4.6.3. Statistical Analysis

A power calculation based on the findings by Smith, Joiner and Dodd (2014) estimated that a sample size of 56 per group would be required to provide an effect size of .53 with power at .80 (calculated using the G*Power program; Erdfelder, Faul & Buchner, 1996). Mann Whitney U and independent t-tests were used to compare groups on quantitative variables. Data analyses were performed on IBM SPSS version 20.0. The p-value for two-tailed significance was set to .05 and the Bonferroni correction was used to correct for multiple-testing.

4.7. Results

4.7.1. Socio-demographic and clinical characteristics of sample

There were 71 women who participated in the study, of these 33 women had AN and 38 healthy women. Within the AN group, the average duration of illness was 7.99 years (SD=6.32), the majority were taking psychiatric medication (70%) and over half had a previous hospital admission for their ED (57%). Sixteen participants were current inpatients.

The socio-demographic variables, clinical characteristic and self-report variables are presented in Table 4. As expected women with AN had significantly lower BMI and higher clinical measures than HC. Age, perceived social support and approach motivation was similar between groups. AN had spent significantly less time in education and reported more avoidant motivation compared to HC.

Table 4. Demographic and social variables presented for each group of women (AN: Anorexia Nervosa; HC: Healthy Controls)

	AN	HC	Test statistic
Age: median (IQR)	23 (20-26)	24 (21.25-25)	U=430.500, p=.627
Years of education: median (IQR)	15 (14-17)	17 (16-18)	U=265.000, p=.006
BMI: mean (sd)	14.74 (1.70)	21.61 (2.08)	T(69) -15.078, p<.001
EDEQ global: median (IQR)	5.28 (4.34-6.19)	1.51 (1.77-1.91)	U=39.000, p<.001
EDEQ-R: median (IQR)	5.20 (4-6.15)	1.55 (1-2.15)	U=39.000, p<.001
EDEQ-WC: median (IQR)	5.30 (4-6)	1.50 (1-2.20)	U=86.000, p<.001
EDEQ-SC: median (IQR)	5.81 (4.78-6.72)	1.63 (1.50-2.38)	U=53.000, p<.001
EDEQ-EC: median (IQR)	4.6 (3.6-5.4)	1 (1-1.35)	U=14.000, p<.001
DASS-D: median (IQR)	34 (13.75-23)	18 (14-21.50)	U=101.500, p<.001
DASS-A: median (IQR)	16 (11.5-20.25)	16 (14-18)	U=66.000, p<.001
DASS-S: median (IQR)	20 (17-24.50)	10 (8-12)	U=65.500, p<.001
OSS: median (IQR)	10 (8-11)	9 (8-11)	U=421.500, p=.848
BIS: median (IQR)	25.50 (24-27.25)	21 (18-24.75)	U=195.000, p<.001
BAS-D: median (IQR)	11.50 (9-13.25)	10 (8-12)	U=359.000, p=.085
BAS-FS: median (IQR)	10 (9-12)	11 (10-12.75)	U=373.500, p=.128
BAS-RR: median (IQR)	16 (14-17.25)	16 (14.25-17)	U=470.500, p=.892

4.7.2. Self-criticism

Self-criticism was similar between AN and HC (AN: median=21.50, IQR=20=28.07; HC: median=25, IQ=19.75-31.50; U=318.000, p=.822, d=.10). There was no difference on the task between participants taking medication and not taking medication (U=39.000, p=.389).

4.7.3. Processing of self-descriptors

The mean RT for AN and HC are presented in Table 5. RT for processing of negative (U=472.000, p=.201) and positive affective (U=500.000, p=.350), negative general (U=502.000, p=.363) and neutral words (U=526.000, p=.539) were similar between groups. A total RT score for all words was computed. The groups were similar in total time to respond (U=478, p=.229, d=.20). Groups were similar on accuracy in identification of words and non-words. There was no significant difference on performance on the task between those who were taking medication and those who were not.

Table 5. Reaction times from Lexical Decision Task (ms) for each group of women (AN: Anorexia Nervosa; HC: Healthy Controls)

	AN	HC
Negative relational: median (IQR)	640.315 (598.98-714.23)	609.723 (549.70-695.97)
Positive relational: median (IQR)	658.000 (598.98-714.23)	620.700 (561.08-684.87)
Negative general: median (IQR)	669.745 (619.99-736.83)	643.133 (611.10-743.50)
Neutral: median (IQR)	652.333 (598.00-725.70)	636.100 (567.03-732.35)

4.7.4. Correlations between measures of self-concept, approach/avoidance and social support

Self-criticism was examined in relation to social support. There was no significant correlation between social support and self-criticism. Attitudes to self-descriptors were examined in relation to approach and avoidance motivation. There was no significant association between approach and avoidance motivation and attitudes towards self-referent words. Depression was not a correlate of either self-criticism or attitudes towards self-referent words.

4.8. Discussion

Negative self-evaluation is proposed to be related to the maintenance of AN (Stein, 1996). It has been suggested that attempts to control weight and shape could be aimed at repairing self-concept (Bruch, 1982). The aim of this study was to assess implicit self-concept, as measured by experimental tasks, in relation to self-reported behavioural inhibition and social support in women with AN.

4.9. Self-criticism

Our first hypothesis was not supported, we found that women with AN and healthy women had similar levels of self-criticism on the Implicit Self-Criticism Task (Perkins, personal communication). We had expected that women with AN would be more self-critical than healthy women as indicated in previous studies (e.g. Bers & Quinlan, 1992). The finding that people with AN were not overly self-critical at an implicit level was unexpected for two reasons. Firstly, the preliminary results from a sample of nine AN patients in Belgium show that the clinical group were significantly more self-critical than controls as assessed by the Implicit Self-Criticism Task (Perkins, personal communication). Secondly, that high self-criticism has been reported at an explicit level. Earlier work shows that people with ED were overly self-critical in a self-report questionnaire (Lehman & Rodin, 1989).

A further surprise was that implicit self-criticism was not found to be a correlate of social support. In contrast to previous work, which showed that self-criticism predicted an increase in stress and a decrease in interpersonal support in a non-clinical sample (Priel & Shahar, 2000). It is unclear whether the null finding between the clinical and control group on the Implicit Self-Criticism Task was due to limitations with the measure (as discussed below in 4.11) or indicates that self-criticism does not operate at an automatic level. Without a direct comparison of implicit and explicit self-criticism it is difficult to interpret our finding.

4.10. Attitudes towards self-descriptors

We did not find evidence to support our second hypothesis which was that people with AN would preferentially process negative affective self-descriptors, in contrast to negative general or positive affective self-descriptors compared to healthy women as measured by the LDT (Krahe, Harrison, Paloyelis & Fotopoulou, personal communication). The finding that women with AN did not preferentially process negative affective self-descriptors was surprising. A previous study which has used the LDT with ED related words, reported that women with AN responded more quickly to 'beautiful' and 'ugly' than controls did (Smith, Joiner & Dodd, 2014). This difference in responses to the same task may indicate that preferential processing of word stimuli may be specific to appearance related words than those that are affective. The lack of support for the hypothesis is inconsistent with earlier work which showed that people with ED were slower to process affective words (Stormark & Torkildsen, 2004; Waller & Ruddock, 1995).

The finding that approach and avoidance tendencies were not correlates of attitudes towards personally referent words was unexpected. Earlier work showed that people with AN were sensitive to punishment and have a low reward reactivity (Harrison, Treasure, & Smillie, 2011). It would seem that people with AN preferentially process word stimuli which are related to appearance, but not those which are affective in nature. It is important to state that it is difficult to objectively compare responses on other affective word tasks with those presented in the current study due to differences in task (e.g. instructions).

4.11. Strengths and Limitations

4.11.1. Strengths

The main advantage of this study was the use of experimental tasks to assess self-concept. Previous studies had included mainly self-report questionnaires, which are prone to bias, or tasks with disorder relevant stimuli, which limited the ability to understand implicit processing of self-concept.

4.11.2. Limitations

There were several disadvantages of this study which need to be considered. Firstly, the use of experimental tasks, for which the validity is unknown, is problematic. It is uncertain whether issues with task validity contributed to the lack of support for the hypothesis in the current study. There is ambiguity about whether the Implicit self-criticism task assesses implicit processes, given that participants evaluation of their performance is based on a Likert scale rating rather than more

automatic processes, such as RT as in other implicit tasks (e.g. IAT). Secondly, there are issues related to power. The study contained a small sample size and so was under powered according to the power analysis provided in the Statistical Analysis section, therefore limiting the ability to formally test models. The combination of issues largely to do with task validity and power may have contributed to the lack of support for the hypotheses in the current study.

4.11.3. Future directions

In order to address the shortcomings of the current study, replication is required with a larger sample size to investigate self-concept in AN. Further knowledge is required about the validity and reliability of the tasks used, which would allow for an information interpretation of the results and also a comparison of the tasks in relation to other more widely used measures (e.g. IAT). In addition the inclusion of both implicit and explicit measures to assess self-concept would allow for a more comprehensive understanding about the behaviour. This information could then be translated to dual-system models to understand whether self-concept in AN is congruent between conscious and less conscious processes. For example, people have been found to be particularly defensive if they show high scores on explicit self-esteem measures and low scores on implicit measures (Jordan, Spencer, Zanna, Hoshino-Browne & Correll, 2003).

4.12. Clinical implications

Personality traits like self-criticism have been argued to moderate symptoms of a variety of psychopathologies (e.g. Blatt, 2004). Earlier work had shown that explicit self-criticism was higher in those with AN (Bers & Quinlan, 1992) and that individuals with ED had lower levels of implicit positive self-evaluation than controls (Cardi et al., 2014). Similar distortions in self-concept were not found in the present study, although the lack of findings may have been due to the shortcomings mentioned above. Negative self-concept has been proposed to be related to the maintenance of AN (Stein, 1996). Approaches like mindfulness (e.g. Baer, Fischer, & Huss, 2005) or compassion-focused therapy (e.g. Adams & Leary, 2007; Gilbert, 2010; Kelly, Carter, & Borairi, 2013) could be used to address more general aspects of negative self-concept in AN.

4.13. Conclusion

This study explored implicit self-criticism and attitudes towards affective self-descriptors. Unexpectedly women with AN did not differ to controls in implicit self-criticism or in attitudes

towards personally referent words. These findings may be contextualised within the context of self-reflection, as people with AN appear to have low reflective self-functioning (Ward et al., 2000). It is important to consider studies examining self-reflection as they are suggested to be related to other aspects of social cognition such as meta-cognition, theory of mind and alexithymia (Dimaggio, Vanheule, Lysaker, Carcione & Nicolo, 2009).

Chapter 5

Socio-emotional processing in eating disorders

5.1. Theoretical models of socio-emotional processing in Eating Disorders

As described in Chapter 1, people with ED are considered to have problems in several of the domains of social emotional processing which have been implicated as causal (Connan et al., 2003) and/or maintaining factors in aetiological models (Schmidt & Treasure, 2006; Treasure et al., 2012; Treasure & Schmidt, 2013). Several systematic reviews and meta-analyses on social processing in EDs have provided support for these models (Oldershaw et al., 2011; Zucker et al., 2007). Recently Arcelus and colleagues (Arcelus et al., 2013) proposed the Interpersonal Functioning Model of ED which suggested that social maladjustment, including social inhibition and lack of social support, maintains ED psychopathology. The model states that people with ED are more likely to avoid emotional expression, especially in the context of negative evaluation, which could deter attempts to seek social support. Maladaptive childhood attachment is thought to contribute to the development of interpersonal problems in individuals who restrict.

The meta-analysis presented in Chapter 3 showed that people with ED have difficulties in key aspects of emotional processing, including recognising facial signals (d=0.44) and in facial communication (d=1.56-d=.16) and avoidance (d=1.68-d=.70). Social and emotional processes are believed to be substantially intertwined (e.g. Keltner & Kring, 1998). Facial expressions play an important role in social interaction, as they convey emotional states and intentions (Ekman & Friesen 1976; Schmidt & Cohn, 2001). It has been proposed that attending to, mimicking and interpreting facial expressions of emotion are important elements of interpersonal interactions (Norris et al., 2004). Cognitive bias, poor facial expression and problems with emotional recognition have been reported in other mental health conditions (e.g. In-Albon et al., 2013). These anomalies could play a role in interpersonal interactions and have the potential to reinforce psychopathological symptoms. The study presented in this chapter will investigate emotional reactivity to emotional information in ED. Since anomalies were not found in self-concept in the previous chapter, the purpose of this chapter will be to investigate emotional aspects of Interpersonal factors of the C-IMM (Schmidt & Treasure, 2006).

5.2. Emotional expressions

Six basic types of expressions have been identified (happiness, surprise, sadness, disgust, fear and anger; Ekman & Friesen, 1976). Emotional expressions can be positively (happiness) or negatively valenced (anger, sadness, fear, disgust), while others are more ambiguous (surprise).

5.2.1 Positive expressions

People show a particular advantage for processing positive expressions. Happy expressions are identified more quickly and accurately than the other five types of expressions (Calder, Young, Keane, & Dean, 2000; Calvo & Lundqvist, 2008; Tottenham et al., 2009) a finding which is consistent across a range of stimulus sets (e.g. KDEF; Lundqvist, Flykt, & Öhman, 1998); PoFA (Ekman & Friesen, 1976); NimStim (Tottenham, Borscheid, Ellertsen, Marcus, & Nelson, 2002). The advantage for processing happy faces may be related to their uniqueness in comparison to other expressions (Calvo & Beltran, 2013) and their normalisation in day to day interpersonal interactions. Smiling is associated with increased sociability and with the elicitation of positive responses (Sullivan et al., 1991).

5.2.2. Negative expressions

In adults negatively valenced emotions appear to be hierarchically processed, with sadness and disgust processed earlier (70-200ms) than anger and fear (100ms-250ms) (Du & Martinez, 2013). Sad and angry expressions are of particular importance to investigate as they regulate social interactions. Sadness has been related to the elicitation of prosocial behaviour and the inhibition of aggression (Miller & Eisenberg, 1988). Displays of anger are intended to curtail the behaviour of others in situations where they might not have adhered to social expectations (Averill, 1983). Angry expressions are widely regarded as threatening stimuli. Dissociable neural substrates are associated with the processing of sad and angry expressions. The left and right amygdala and right inferior and middle temporal gyri are activated in response to sadness. Angry expressions are associated with activation in the right orbitofrontal cortex. Both sad and angry expressions are related with the anterior cingulate cortex and the right temporal lobe (Blair, Morris, Frith, Perrett, & Dolan, 1999).

5.2.3. Infant faces

Compared to the processing of adult faces, infant faces are linked with activation in multiple neural regions (Parsons, Young, Murray, Stein, & Kringelbach, 2010; Swain, Lorberbaum, Kose, & Strathearn, 2007) including those associated with reward processing, such as the orbitofrontal cortex (Kringelbach et al., 2008; Leibenluft, Gobbini, Harrison, & Haxby, 2004), and with the

anticipation of reward, for instance the nucleus accumbens (Glocker et al., 2009). Also infant faces are associated with regions which are involved in attentional processing, such as the precuneus (Glocker et al., 2009). People allocate more attention to infant faces when presented in the left visual field as opposed to the right visual field (Brosch, Sander, & Scherer, 2007).

5.3. Components of socio-emotional processing

5.3.1. Attentional processing

Evolutionary models of emotion propose that the main function of the attention system is to selectively attend to information of biological significance (e.g. Panksepp, 1998). According to Frenwen and colleagues (Frewen, Dozois, Joanisse, & Neufeld, 2008) there are two distinct attentional systems, for detection of reward and threat. The reward-related system is the primary attention orientation system. The secondary threat detection system interrupts the reward system in the presence of veritable danger, but it can be maladaptive if it is too sensitive and consistently disturbing the reward detection system (Mathews, 2005). Attentional biases towards negative information relative to reward or neutral stimuli have been consistently reported in clinical populations with disorders like depression and anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007) and have been proposed to be related to both the aetiology and maintenance of these disorders (Mathews, 2005). Selective processing of positive information and avoidance of negative material is suggested to contribute to mental health and wellbeing (Fox, 1993). Perceived loneliness may contribute towards increased attention towards social threat (Cacioppo & Hawkley, 2009).

The distinction between automatic orienting of attention and the maintenance or disengagement of attention is important to consider (Corbetta & Shulman, 2002). Currently there is debate over the early and late aspects of selective attention, but it is generally accepted that exposure durations of less than 200ms are associated with automatic shifting of attention while stimuli presented for 500ms or longer are related to a bias in the disengagement of attention (Field & Cox, 2008; Cisler & Ernst, 2010). It has been proposed that initial orientation of selective attention can be investigated by employing short stimulus onset asynchrony (SOA) (e.g. 50-200ms) which allows for participants to make a single shift of attention toward either one of the stimuli presented, in contrast with longer SOA where participants are able to make several shifts of attention, reflected either in their maintenance towards or disengagement from the stimuli (Bradley, Field, Mogg & DeHouwer, 2004).

5.3.2. Attentional processing in Eating Disorders

People with ED show anomalies in attentional processing, they are vigilant to negative emotional expressions and pay less attention to social reward in comparison to controls. Unlike HC, people with AN find it difficult to pay attention to signals of social reward. People with AN and BN selectively attend to a neutral face in favour of a kind expression (Cardi et al., 2012). Compared to controls, people with AN showed a strong interference effect in their ability to name colours in the angry faces condition (Harrison, Sullivan, et al., 2010; Harrison, Tchanturia, et al., 2010). Individuals with AN and BN selectively attend to critical (Cardi et al., 2012) and dominant expressions (Cardi et al., 2014). Attention to critical expressions is associated with childhood adversity in ED (Cardi et al., 2012). People with AN looked away more frequently from a film clip showing a sad scene (Davies et al., 2011). In response to line drawings of faces, people with AN show an increased vigilance to sadness and anger, but were less attentive to happiness (Cserjesi et al., 2011).

5.3.3. Emotional identification in Eating Disorders

People with ED show difficulties identifying emotions in themselves and in others. The meta-analysis presented in Chapter 3 showed that people with ED had difficulty in recognising facial expressions (d=0.44). The recognition of facial expressions of basic emotions in ED appears to be particularly poor for negative emotions (Zonnevylle-Bender et al., 2002; Kucharska-Pietura et al., 2004), although these findings have not been consistently replicated (Kessler et al., 2006; Rozenstein et al., 2011; Kenyon et al., 2012). The meta-analysis presented in Chapter 3 reported that people with ED experienced high levels of alexithymia compared to controls (d=.66). In response to emotional information, adults with AN reported less positive feelings in response to the positive film clip (Davies et al., 2011). However, their subjective experience of negativity in response to tragic film clips was similar to that of HC. While adolescents with AN had a similar subjective emotional experience in response to comic and tragic cartoons as HC (Rhind et al., submitted).

5.3.4. Facial expressions

It has been proposed that humans are predisposed to have emotional reactions to facial expressions of emotion; individuals react automatically and spontaneously with congruent facial reactions i.e. facial mimicry (Dimberg, 1990, 1997). It has been suggested that imitation of others might engender affiliation, liking and rapport (Hatfield, 1992; Lakin & Chartrand, 2003). Reduced facial expression has been identified in clinical populations who experience social difficulties, such as individuals with

depression (Berenbaum & Oltmanns, 1992) and schizophrenia (Kring & Neale, 1996). It has recently been shown that individuals with active psychosis have abnormal mirror neuron activity as measured through electroencephalography (McCormick et al., 2012).

5.3.5. Facial expression in Eating Disorders

People with ED show fewer facial expressions of emotions. Adults and adolescents with AN show reduced facial expression in response to emotional scenes in film clips. When shown a comic and tragic film scene, people with AN had fewer facial expressions than controls (Davies et al., 2011; Rhind et al., submitted). Depression and duration of illness, but not weight, was found to explain attenuation in facial expression to the positive film scene(Davies et al., 2011). Findings of altered facial expression in ED are evident in non-social contexts. People with AN showed fewer facial expressions of anger than controls while playing a video game. Those with BN had similar levels of expressions of anger as controls when playing the game. Frequency of expression of joy was similar between AN and HC when playing the game (Claes et al., 2012). When shown explicit food pictures and subliminal affect pictures, people with AN showed less intense facial emotion expression than HC in response to photographs of food (Soussignan, Jiang, Rigaud, Royet, & Schaal, 2010).

5.4. Clinical characteristics of Eating Disorders

5.4.1. Neural processing

Neuropsychological studies show that people with ED process emotional information differently to those without an ED. Women with AN showed differences in their visual-evoked potentials (VEP) to emotional expressions compared to HC. They made more mistakes in recognition of sadness, disgust and neutral faces (Pollatos, Herbert, Schandry, & Gramann, 2008). When shown angry and disgusted faces, people with BN had a decreased neural response compared to HC. They also had a reduced response in the right amygdala in response to anger (Ashworth et al., 2011). People recovered from an ED show alterations in processing of rewarding and theory of mind tasks, but processing of emotional information appears to remit during the recovered period. People who have recovered from AN show reduced activation in the right temporoparietal junction (RTPJ), associated with the social cognition network, in a Theory of Mind moving shapes task (McAdams & Krawczyk, 2011). Alterations in emotional processing have been observed in the recovered state. People who had recovered from AN showed no significant differences in neural response to fear and happy expressions compared to HC (Cowdrey, Harmer, Park, & McCabe, 2012). During the acute phase of

the illness, people with ED process emotions differently to controls, this difference is no longer found when recovered from the illness.

5.4.2. Personality traits

Several features of ED personality traits and clinical characteristics may be involved in emotional processing. People with ED show irregularities in approach and avoidance, they have an increased sensitivity to punishment and a decreased sensitivity to reward (Harrison et al., 2011). It has been reported that people with AN show greater levels of social anhedonia (Tchanturia, Davies, Harrison, et al., 2012), they fear and avoid intense emotions (Russell et al., 2009) and they have high levels of harm avoidance (Bulik, Sullivan, Weltzin, & Kaye, 1995). The authors of a recent review of alexithymia suggest that high levels of alexithymia contribute to a general deficit in processing emotional facial expressions or vice versa, with the largest impairment to understanding sadness (Grynberg et al., 2012).

5.4.3. Comorbidity with depression and anxiety

It is unclear whether difficulties in emotional processing found in ED are causal factors or a consequence of depression and anxiety. Symptoms of depression and anxiety are highly comorbid with ED (Braun, Sunday, & Halmi, 1994; Kessler et al., 2012). Attention to negatively valenced information could be secondary to the effects of mood change, as individuals who are at risk for depression showed threat related attentional biases in a negative mood induction condition (Joormann, Talbot, & Gotlib, 2007).

5.4.4. State and trait effects

It has been suggested that difficulties in social emotional processing may persist after recovery (Wentz, Gillberg, Gillberg, & Rastam, 2001). It remains unclear whether emotional processing problems persist in individuals following recovery or are secondary to the effects of starvation. A comparison of those currently ill to those who have recovered would allow for the possibility to distinguish state or trait differences. There is evidence to suggest that attention to social threat signals remain heightened during the recovered state (Cardi et al., 2014; Cardi et al., 2012; Harrison, Tchanturia, et al., 2010).

5.5. Early adversity

A hypersensitivity to threat and hyposensitivity to reward is linked with early adversity. Studies of children who were maltreated report that they show alterations in processing of emotional information according to the type of abuse. Children who were maltreated paid more attention to pictures of sadness (Romens & Pollak, 2012) and less to anger (Pine et al., 2005). Children who had been physically abused were found to both attend and disengage from angry faces (Shackman, Shackman, & Pollak, 2007; Pollak & Tolley-Schell, 2003). Children who had been abused processed anger differently to children who had not experienced abuse (Pollak & Kistler, 2002). A preference to attend to angry faces was found in adults who had experienced abuse in childhood (Gibb, Schofield, & Coles, 2009). There is converging evidence to suggest that childhood neglect may influence facial affect processing in depression (Bistricky, Ingram, & Atchley, 2011).

5.6. Approach and avoidance

Traditionally pleasant stimuli are associated with appetitive responses, while unpleasant information is related to withdrawal. Distinctions in approach and avoidance behaviour have been reported in response to happiness and anger, with healthy volunteers showing slower approach to anger than to happiness (Stins et al., 2011). Difficulties in approach and avoidance behaviour has been reported in individuals with depression, who were reported to be less likely to rate happy faces as approachable and typically rated more avoidant tendencies from sad faces (Seidel et al., 2010). A recent imaging study showed that people with depression show impairments in social approach and withdrawal behaviour when confronted with happy and angry expressions; for example those with depression had reduced amygdala activation during approach to happy expressions and people with depression showed more withdrawal than controls (Derntl et al., 2011).

5.7. Conclusion

5.7.1. Summary

Facial expressions play a key role in interpersonal interactions (Ekman & Friesen, 1976). Attention (e.g. Panksepp, 1998), emotional identification and facial mirroring of expressions (Dimberg, 1990, 1997) are key aspects of socio-emotional processing of facial signals. Problems with social and emotional processing have been implicated in the maintenance of ED (Schmidt & Treasure, 2006; Treasure et al., 2012; Treasure & Schmidt, 2013). Socio-emotional difficulties, such as avoidance of expression, are proposed to contribute to interpersonal difficulties (Arcelus et al., 2013). People with ED show anomalies across in several key components of socio-emotional processing, such as in

attention (Harrison, Sullivan, et al., 2010; Harrison, Tchanturia, et al., 2010; Cardi et al., 2012; Cardi et al., 2014; Cserjesi et al., 2011), emotional identification (Oldershaw et al., 2011; Davies et al., 2011; Rhind et al., submitted) and in facial expression (Davies et al., 2011; Rhind et al., submitted). There appear to be key similarities and differences between those with AN and BN in aspects of social-emotional processing. For example attentional processing appears to be similar (e.g. Cardi et al., 2012), while facial expressions of anger were similar between those with BN and HC (Claes et al., 2012). There has been no research exploring how people with ED respond to infants.

5.7.2. Response to infants

Infant faces contain particular features which elicit caregiving behaviours. Ethologist Konrad Lorenz (Lorenz, 1943) defined *Kindchenschema* (-or baby schema) as the infantile qualities of facial features, such as a large head and eyes, which facilitates caregiving behaviour (Langlois, Ritter, Casey, & Sawin, 1995; Volk & Quinsey, 2002) and enhances the infant's chances for survival. Infant's facial expressions of emotion motivates caregiver behaviour and proximity. Infant smiling encourages attachment behaviours (Owren & Bachorowski, 2003) and crying signals information about the child's health (Bowlby, 1969; Soltis, 2004). Parents have been shown to intuitively modify their speech, facial expressions and other movements when interacting with their infant (Papousek, 1977). Maternal viewing of own infant has been reported to produce higher positive mood ratings (Nitschke et al., 2004). Maternal imitation of own infant expressions, which is linked with the MNS, insula and amygdala, is correlated with maternal empathy (Lenzi et al., 2009). By responding to infant cues, caregivers are able to imitate positive infant behaviour and sooth negative infant behaviour (Brazelton, Koslowski, & Main, 1974; Papousek, 2007). This variation in caregiving response has implications for infant communication. For example, high levels of maternal mirroring is associated with high levels of infant prosocial behaviour (e.g. more smiles), while lower levels of maternal mirroring is related to less infant prosocial behaviour (Legerstee & Varghese, 2001).

5.8. Study aim

The aim of this study is to examine emotional reactivity to faces expressing basic positive and negative emotions (i.e. happiness, sadness, frustration) displayed by adults and infants, in EDs, using explicit (i.e. self-reports) and implicit measures (dot probe and facial expression recording). The identification of specific strengths and weaknesses in socio-emotional processing in ED is important to guide treatment targeting interpersonal functioning. Infant faces are biologically salient stimuli, they are both highly rewarding (e.g. Glocker et al., 2009; Kringelbach et al., 2008; Leibenluft et al., 2004; Parsons et al., 2010; Swain et al., 2007) and elicit strong caregiver responses (e.g. Langlois,

Ritter, Casey, & Sawin, 1995; Volk & Quinsey, 2002). It is important to examine whether infant faces, compared to adult faces, potentiate emotional responses in ED. This comparison will allow for an understanding of whether higher socially rewarding stimuli (i.e. infant faces) influence emotional responses in ED.

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5.9. Hypotheses

In response to images of adults and infants displayed in a dot-probe task (attentional index score calculated) and from self-report questionnaires, we expected the following:

Attentional processing

1. Women currently ill with an ED will selectively attention to sad expressions in favour of neutral expressions (e.g. Cserjesi et al., 2011). Also, they will selectively attend to neutral expressions in comparison to happy expressions (e.g. Cserjesi et al., 2011).
2. Women who have recovered from an ED and HC will show the opposite type of attentional deployment to women currently ill (i.e. they will attend to the neutral face in favour of the sad face; they will attend to the happy face in favour of the neutral face) (Cardi et al., 2014; Cardi et al., 2012; Harrison, Tchanturia, et al., 2010).
3. The expected patterns of attentional deployment would be predicted by childhood adversity (Gibb, Schofield, & Coles, 2009). Low perceived social support (Cacioppo & Hawkley, 2009), low approach and high avoidance behaviour (Harrison et al., 2011) and high depression (Braun, Sunday, & Halmi, 1994; Kessler et al., 2012) would be correlates of the expected pattern of attentional processing outlined in the first hypothesis.

The outcomes from the film task were identification of others' emotion (Emotional Affective Scale), subjective emotional reactivity (Positive and Negative Affective Scale), facial mirroring and avoidance (count of frequency). In response to film clips of adults and infants depicting happiness, sadness and frustration we anticipated the following:

Identification of others' emotions

4. Women currently ill with an ED would rate others' emotions as less intense compared to individuals who had recovered from an ED or HC (e.g. Oldershaw et al., 2009). Individuals who had recovered would have ratings in between those currently ill and HC.

Subjective emotional reactivity

5. Women currently ill with an ED would report lower subjective emotional reactivity to happy, sad and frustrated displays (Davies et al., 2011). Women who had recovered would have ratings in between those currently ill and HC.

Facial expressions

6. Women currently ill and recovered from an ED would have less facial expressions and more instances of avoidance in response to adults displaying happiness, sadness and frustration in film clips compared to HC (Davies et al., 2011; Rhind et al., submitted). Women who had recovered would have levels of facial expressivity in between those currently ill and HC. This facial communication style would be predicted by childhood adversity (Gibb, Schofield, & Coles, 2009). Perceived social support (Cacioppo & Hawkley, 2009), approach and avoidance behaviour (Harrison et al., 2011) and depression (Braun, Sunday, & Halmi, 1994; Kessler et al., 2012) would be correlates of facial expression.

Adults vs. Infants

7. We expected that the above hypotheses would be more prominent in emotional responses to infant faces than those to adult faces, given their relative salience (e.g. Kringelbach et al., 2008; Leibenluft, Gobbini, Harrison, & Haxby, 2004).

5.10. Methods and materials

5.10.1. Participants and recruitment

A core sample of 152 participants were recruited, 49 women with AN, 16 women with BN, 13 women who were recovered from AN (AN-Rec) and 74 HC with no previous history of an ED. One-hundred and eighty three people were initially screened for the study and 31 participants were excluded. Twenty-five of these did not meet the inclusion criteria for the HC group, five participants were excluded from the AN-Rec group as they did not meet the criteria for no binge eating, purging, or fasting in the prior three months and a single participant from the AN group was excluded as they had an associated neurological condition (see demographic information requested in Appendix A1).

A DSM diagnosis of an ED was obtained from a clinician or using the Structured Clinical Interview for DSM-IV Extended Module H (First et al., 1996). Participants without a current ED were considered recovered if they had a BMI (weight/height^2) of at least 18.5, reported no binge eating, purging, or

fasting in the prior three months (Bardone-Cone et al., 2010; Couturier & Lock, 2006) and had subscale scores on the EDED-Q (Fairburn & Beglin, 1994) within 1 SD of age-matched community norms (Mond et al., 2004). Exclusion criteria for all participants were visual or motor impairment and additional exclusion criteria for HC were: a BMI outside the range of 18.5–30kg/m², depression scores above the moderate cut-off (> 20) DASS (Lovibond & Lovibond, 1995) criterion, reported a mental illness or psychiatric medication. Participants were recruited through advertisements from the Institute of Psychiatry's Section of ED volunteer database, the b-eat website and through a circular email sent out to the staff and students at KCL and University College London (UCL). The study received ethical approval (PNM/10/11-111; see Appendix A14) and all participants provided informed consent.

5.10.2. Self-report measures

Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994)

The EDE-Q is a 36-item questionnaire which assesses the main behavioural features of ED over the past 28 days (see copy in Appendix A2). The EDE-Q consists of four subscales: weight, shape and eating concern and dietary restraint. A global score is calculated using the composite mean of these subscales with higher scores indicating greater ED pathology. In a recent systematic review of the literature the EDE-Q was found to have good internal consistency in adult women with BN and findings from published studies supported the ability of the EDE-Q to distinguish between cases and non-ED cases (Berg, Peterson, Frazier and Crow, 2012). The EDE-Q has been reported to have moderate to high concurrent and criterion validity (Mond et al., 2004). The Cronbach's alpha for the sample tested in this study was 0.90.

Depression Anxiety Stress Scales-21 (DASS) (Lovibond & Lovibond, 1995)

The DASS is a 21-item questionnaire which assesses symptoms of depression, anxiety and stress during the past week (see copy in Appendix A3). The DASS-21 has good construct validity (Henry & Crawford, 2005), internal consistency and has good concurrent validity with the DASS-42 (Antony, Bieling, Cox, Enns, & Swinson, 1998). Higher scores represented greater feelings of depression, anxiety and stress symptoms (Lovibond & Lovibond, 1995). The total Cronbach's alpha for the sample included in this study was 0.94.

Behavioural Inhibition System and Behavioural Approach System (BIS/BAS) (Carver & White, 1994)
The BIS/BAS contains 24-items which measures personality dimensions, reflecting the sensitivity of the aversive and appetitive motivational systems (BAS-D; BAS-FS and BAS-RR) (see copy in Appendix A5). The BIS/BAS has good internal reliability and reasonable alpha reliability (Carver & White, 1994). Higher scores represent a greater sensitivity in either system. The overall Cronbach's alpha for the sample tested in the current study was 0.72.

Oslo Social Support (OSS) Scale (Meltzer, 2005)
The OSS is a 3 item questionnaire which measures the level of general social support from close confidants, other people and neighbours (see copy in Appendix A4). The sum of the OSS can be interpreted according to three categories: poor support 3-8; moderate support 9-11; strong support 12-14 (Boen et al., 2012).

The Childhood Experience of Care and Abuse Questionnaire-2 (CECAQ2) (Bifulco, Bernazzani, Moran, & Jacobs, 2005)
The CECA-Q assesses loss or separation from parents before the age of 17, close relationships with adults and children, physical punishment and unwanted sexual experiences (see copy in Appendix A6). Two subscales measure parental antipathy and neglect (16 questions). The test-retest reliability has been found to be satisfactory for the abuse and care subscales (Bifulco et al., 2005).

5.10.3. Computerised tasks

Visual probe task
A visual dot-probe task was used to measure attentional processing (Posner, Snyder, & Davidson, 1980). The dot-probe task was presented on E-Prime version 2 (Psychology Software Tools, Inc., Pittsburgh, PA). Each trial began with a central fixation point shown for 500ms, which was then replaced by a picture pair that appeared for 500ms. Immediately after the offset of each picture pair, a probe (e.g. ":" or "..") was presented in the location of one of the pictures. Participants were instructed to identify the probe (e.g. ":" or "..") as quickly and as accurately as possible. A keyed response ended the trial.

The stimuli were presented for 500msec replicating the SOA from an earlier study which examined attentional response to emotional stimuli in a dot-probe paradigm in ED (Cardi, et al., 2012). As described previously in section 5.3.1., long exposure presentations (e.g. above 200ms) would be considered to assess maintenance or disengagement of attention.

The task consisted of 16 practice and 64 experimental trials. There were 12 happy-neutral pairs and 12 sad-neutral pairs which were repeated twice and presented in random order for each participant.

Participants completed two separate dot-probes. The first presented photographs of adult faces and the second showed images of infant faces. The adult faces were obtained with permission from the Pictures of Facial Affect set (Ekman & Friesen, 1976). They consisted of 24 photographs of adult faces showing prototypical expressions which were happy, sad or neutral. Twenty-four photographs of infant faces were obtained from a validated collection with approval from the author (Kringelbach et al., 2008; Parsons, Young, Kumari, Stein, & Kringelbach, 2011).

Film Task

The film task in the current study was based on the methodology used by Davies and colleagues (Davies et al., 2011). The protocol for the order and the viewing of the film clips (described in section 5.10.4.), scoring facial expression response (described in section 5.10.5.) and the data reduction and analyses (described in section 5.10.6.) were replicated from the study by Davies and colleagues (Davies et al., 2011). The adaptations to the film task in the current study include: the experimental stimuli shown (described below) and the use of measure of the identification of others' emotions.

Film Task: Experimental stimuli

Four film clips presented adults displaying different discrete emotions. The film clip depicting happiness shows an adult joyous and smiling; the clip conveying sadness shows an adult visibly upset and crying; the clip which portrays frustration shows an adult angry and annoyed. The neutral film clip shows an adult with a still neutral expression. The film clips of the infants displaying the same discrete emotions as the adults had (neutral, happiness, neutral, frustration and sadness) followed the same format.

The film clips were sourced from YouTube and the clip depicting a frustrated infant was used with approval from the author (Leerkes, 2010; Leerkes, Weaver, & O'Brien, 2012). The film clips were chosen as they presented corresponding adult and infant emotions. Attempts were made to match the film clips according to length and the display of a single person in the frame. The film clips were viewed by fifteen HC and were selected on the basis that they elicited the appropriately valenced response on the Emotional Assessment Scale and the Positive and Negative Affect Scale. Each film clip was ~ 1 minute in length.

Following the method by Davies and colleagues (Davies et al., 2011), the order of the film clips was fixed and based on the premise that negative affect has a more lasting carry over effect. Film clips were presented in the following order: 'neutral' (baseline), 'happy', 'neutral' (repeated), 'frustrated' and 'sad' on a 15-inch computer screen.

Film Task: Ratings

Emotional Assessment Scale (EAS) (Carlson et al., 1989)

Participants rated the film clips according to the valence and intensity of the emotion displayed, based on 17 adjectives (e.g. '*frustrated*') on a 5-point scale (see copy in Appendix A7). Two scores were derived from these ratings, those related to positive affect and those related to negative affect. Higher scores on either scale represent a greater intensity of that affect. The EAS has been reported to have good reliability, validity and is reliability consistent with similar emotional scales (Carlson et al., 1989).

Positive and Negative Affect Scale (PANAS) (Watson, 1988)

The PANAS contains 20 adjectives which assess current positive and negative affect (see copy in Appendix A7). Items are rated on a 5-point scale. Scores on the positive affect scale are summed, and higher scores represent higher levels of positive affect and vice-versa for the negative affective scale. The PANAS has been reported to have high internal reliability (Crawford & Henry, 2004), significant stability over time and good reliability for use in clinical samples (Watson, Clark & Tellegen, 1988).

5.10.4. Procedure

Participants completed the self-report questionnaires. After this they completed the dot-probe and then the film task. Participant's faces were recorded with their consent while they were viewing the film clips using a small video camera on a tripod behind the screen, following the methodology used by Davies and colleagues (Davies et al., 2011). After watching each film clip participants rated how they thought the person in the film felt, using the EAS, and how they felt, using the PANAS.
The self-report measures were not included in the initial month of ascertainment and so the numbers are smaller compared to the experimental tasks. Technical difficulties with the film task (e.g. participant moves out of head shot) resulted in loss of some data points.

5.10.5. Facial Coding

The participants' faces were coded according to the Facial Expression Coding System (FACES) (Kring and Sloan, unpublished). A facial expression was described as 'a change from a neutral expression to a non-neutral expression and then back to a neutral expression', additional expressions were considered if the participant's initial expression did not return to a neutral expression or shifted to another affective facial display. Four main facial expression variables were measured: The frequency of a facial expression was counted according to number of positive or negative expressions; the intensity of a facial expression was measured on a 4-point scale; the duration of each facial expression was measured in seconds; the frequency of looking away was counted.

The total scores derived from coding were: (a) the frequency of positive expressions, mean intensity, mean duration; (b) the frequency of negative expressions, mean intensity, mean duration; (c) the frequency of looking away. Two researchers who were blind to subject diagnosis (J.L. and C.R) rated the participants' facial expressions. Inter-rater agreement was high for coding of faces in response to adult faces (κ=.79) and infant faces (κ=.90). For the purpose of these studies, congruent facial displays were included in the analysis: (a) frequency of positive expression to happiness; and (b) frequency of negative expression to sadness and frustration. The term Facial Mirroring was used to describe frequency of congruent facial expression and Facial Avoidance referred to the frequency of looking away.

5.10.6. Statistical Analyses

An attentional index from the dot-probe scores was calculated following the standard procedure (MacLeod, 2002). Correct responses above 200ms and below 2000ms were obtained for the analysis. The response times were all within two SD of the participant's mean. The attentional index was calculated by using the RT for the trials in which the probe replaced the target picture (happy or sad; valid trial) and subtracting these from the RT for the trials where the probe replaced the neutral picture (invalid trial). The difference between these two types of trials are assumed to indicate the location the participant was attending to at the moment of response (MacLeod & Mathews, 1988). Positive bias scores indicate faster reaction times and suggest that attention is directed to probes which replace the target picture (happy or sad) compared to the detection times for the probes which follow the neutral picture. Negative bias scores indicate faster detection times for probes which follow the neutral picture compared to the probes which replace the target picture (happy or sad), they are interpreted as orienting attention away from the stimuli.

Data for Facial Mirroring were obtained in the following way. The frequency of facial expression was used as the prime index of Facial Mirroring as the frequency, intensity and duration of expression FACES variables were all significantly correlated (for positive and negative valence separately), replicating the procedure by Davies and colleagues (Davies et al., 2011) to reduce the number of dependent variables. The frequency of looking away was extracted for Facial Avoidance.

The attentional processing scores were normally distributed according to Kolmogorov-Smirnov tests and by visual inspection of histograms. The attentional processing scores were analysed by using repeated measures analysis of variance (ANOVA), one-way ANOVA and independent t-tests to explore between group differences. Using ANOVA allowed for the investigation of confounding variables. Quantitative data which were non-normally distributed were analysed using the Kruskal-Wallis and Mann-Whitney U tests, this applied for self-report and film task variables. Demographic categorical variables, which are presented in numbers and percentages, were compared with the χ^2 test. Spearman's Rho was used to investigate correlations between both self-report variables and attentional processing and facial expression. For analysis of state and trait differences, the dot probe and film task scores were combined for those with AN and BN into a current ED group. The AN and BN groups were combined primarily to increase power and also on the basis that previous studies (e.g. Cardi et al., 2012) showed there to be no significant difference between AN and BN in attentional processing to emotional faces. Two outliers (1 BN; 1 HC) were removed from the attentional processing analysis through visual inspection of the histograms and one (AN-Rec) from the avoidance of happiness and frustration. As mentioned previously, there were missing data on some of the outcomes. All available data from the sample were included into the analysis. The p-value for two-tailed significance was set to .05. The Bonferroni correction was applied to control for Type I error rate in the following outcomes: EDEQ, DASS, CECAQ, BIS/BAS; Registration, Subjective Emotional Experience and Facial Expression. A power calculation estimated that a sample size of 382 per group would be required to provide an effect size of .20 with power at .80 (calculated using the G*Power program; Erdfelder, Faul & Buchner, 1996), based on the findings by Cardi et al. (2012).Cohen's d ES were calculated and can be interpreted as small (0.2), medium (0.5) and large (0.8) (Cohen, 1988). Statistical analyses were performed using SPSS version 21.

5.11. Results

5.11.1. Socio-demographic and clinical characteristics

The final sample consisted of 152 participants, of those 49 had AN, 16 had BN, 13 were recovered from AN and 74 were HC. Data concerning demographic and clinical information were available for 79% of the sample, as explained earlier this was due to a low return rate of questionnaires. Duration of illness was 4.88 years (6.72) for AN, 2.68 years (3.61) for BN. Those who had recovered from AN reported an average illness length of 5.77 years (7.94). The majority of clinical cases were taking psychiatric medication, 79% of the AN group, 75% of the BN group and 67% of women who had recovered from AN. The minority of HC (7%) and AN (18%) were mothers and none of those with BN or AN-Rec were mothers. Presented in Table 6 and Table 7 are the medians and IQR for the demographic and clinical variables. Age was similar between groups. As expected those with AN had a significantly lower BMI than BN, AN-Rec and HC. BMI was similar between BN, AN-Rec and HC. Disordered eating symptoms on the EDEQ global and subscales were all significantly higher in those with a current ED, AN and BN, compared to AN-Rec and HC. Disordered eating symptoms were similar between AN-Rec and HC. Depression symptoms were significantly higher in those with a current ED, compared to HC and those recovered from AN. Anxiety symptoms were significantly higher in those with a current ED, AN and HC, compared to HC and those recovered from AN and those who had recovered from AN were significantly more anxious than HC. Stress symptoms were significantly higher in those with a current ED, AN and HC, compared to HC and women with AN were significantly more symptoms of stress than those recovered from AN.

Table 6. Demographic, clinical and social variables in women with eating disorders versus healthy controls (AN: Anorexia Nervosa; BN: Bulimia Nervosa; AN-Rec: Anorexia Nervosa Recovered; HC: Healthy Controls)

	AN	BN	AN-Rec	HC	Test-statistic	Post-hoc
Age: median (IQR)	24 (22-32.35)	22 (19-25.75)	23.00 (20.50-29.50)	24 (22-28)	H(3) =3.141, p=.370	-
BMI: median (IQR)	16.20 (14.58-17.12)	21.61 (19.55-23.10)	21.00 (20.05-22.20)	21.40 (19.95-23.30)	H(3) =66.160, p< .001	AN<HC p< .001 BN=HC p=.982 AN-Rec=HC p=.701 AN<BN p<.001 AN<AN-Rec p<.001 BN=AN-Rec p=.720
EDEQ-Global: median (IQR)	3.94 (3.29-4.93)	4.91 (3.45-5.09)	0.59 (0.30-0.68)	0.49 (0.15-1.17)	H(3) =78.148, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec=HC p=.898 AN=BN p=.247 AN>AN-Rec p<.001 BN>AN-Rec p<.001
EDEQ-R: median (IQR)	4.00 (2.40-5.00)	4.30 (2.35-5.10)	0.20 (0.00-0.70)	0.40 (0.00-1.00)	H(3) =67.239, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec=HC p=.655 AN=BN p=.889 AN>AN-Rec p<.001 BN>AN-Rec p<.001
EDEQ-SC: median (IQR)	4.50 (3.5-5.76)	5.31 (4.25-5.84)	0.75 (0.44-1.00)	0.75 (0.25-1.59)	H(3) =69.761, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec=HC p=.874 AN=BN p=.367 AN>AN-Rec p<.001 BN>AN-Rec p<.001
EDEQ-WC: median (IQR)	4.00 (2.50-5.30)	5.30 (4.05-5.75)	0.40 (0.20-0.80)	0.70 (0.00-1.35)	H(3) =73.967, p< .001	AN>HC p< .001 BN>HC p< .001

	AN	BN	AN-Rec	HC	Test-statistic	Post-hoc
						AN-Rec=HC p=.480 AN=BN p=.083 AN>AN-Rec p<.001 BN>AN-Rec p<.001
EDEQ-EC: median (IQR)	3.80 (2.90-4.40)	4.30 (2.55-4.75)	0.40 (0.20-0.60)	0.20 (0.00-0.40)	H(3) =87.638, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec>HC p=.080 AN=BN p=.341 AN>AN-Rec p<.001 BN>AN-Rec p<.001
DASS-D: median (IQR)	26 (12-33)	24 (15-39.50)	4 (1.00-10.00)	2.00 (0.00-4.00)	H(3) =73.283, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec>HC p=.071 AN=BN p=.621 AN>AN-Rec p<.001 BN>AN-Rec p<.001
DASS-A: median (IQR)	12 (6-27)	15 (10-19)	6 (4.00-15.00)	2.00 (0.00-4.00)	H(3) =59.379, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec>HC p=.001 AN=BN p=.790 AN>AN-Rec p=.152 BN>AN-Rec p=.095
DASS-S: median (IQR)	28 (19-35)	22 (10.50-33)	14 (4-21)	6.00 (2.00-10.00)	H(3) =61.560, p< .001	AN>HC p< .001 BN>HC p< .001 AN-Rec>HC p=.043 AN=BN p=.247 AN>AN-Rec p=.001 BN=AN-Rec p=.111

Note. Abbreviations. BMI: Body Mass Index; EDEQ: Eating Disorder Examination Questionnaire; R: Restraint; SC: Shape concern; WC: Weight concern; EC: Eating concern; DASS: Depression Anxiety Stress Scale; D: Depression; A: Anxiety; S: Stress.

Social variables

Data relating to social variables were available for 67% of the sample due to non-return of questionnaires. Presented in Table 7 are the medians and IQR for self-reported experience of childhood adversity, approach and avoidance motivation and social support.

Experience of childhood adversity

Two early adversity variables differed significantly by group, number of close friendships with other children during childhood and perceived maternal antipathy. The majority of clinical cases had close friendships with other children during childhood, although this was to a lesser extent than HC. Women with a current ED perceived maternal antipathy significantly more than HC did (AN d=.73;BN d=1.44). No other significant differences were found.

Approach and avoidance motivation

Two behavioural tendencies differed significantly between groups, behavioural inhibition and fun seeking. Both women with AN and BN reported significantly more behavioural inhibition than HC (AN d=1.15;BN d=.88). Those with AN had significantly less fun seeking then HC (d=.96). There were no other significant between group differences.

Social support

Perceived social support was found to differ significantly by group. Women with BN perceived having significantly less social support than those with all other groups (d=1.41). No other significant differences emerged.

Table 7. Early experience of abuse and neglect, vulnerable attachment, social support and behavioural motivation in women with eating disorders compared to healthy controls (AN: Anorexia Nervosa; BN: Bulimia Nervosa; AN-Rec: Anorexia Nervosa Recovered; HC: Healthy Controls)

	AN	BN	AN-Rec	HC	Test-statistic	Post-hoc
CECAQ2 Mother Antipathy: median (IQR)	17 (11-24.25), n=34	25.50 (14.50-31), n=12	12 (10-20), n=9	11 (9-16), n=72	H(3) =18.855, p< .001	AN>HC p= .001 BN>HC p= .001 AN-Rec>HC p=.280 AN=BN p=.136 AN=AN-Rec p=.369 BN=AN-Rec p=.082
CECAQ2 Mother Neglect: median (IQR)	12.50 (8-19.25), n=34	13 (9.25-16.75), n=12	11 (8-18.50), n=9	11 (9-12.75), n=72	H(3) =3.855, p= .278	-
CECAQ2 Father Antipathy: median (IQR)	18 (10.50-26), n=33	16.50 (12-24.50), n=12	13 (11-21), n=9	12 (9-18), n=70	H(3) =10.307, p= .016	-
CECAQ2 Father Neglect: median (IQR)	15 (9.50-24), n=33	18 (12.25-24.50), n=12	11 (9-19), n=9	12 (9-17), n=70	H(3) =8.370, p= .039	-
CECAQ2 Closeness to Adult(s) (%)	74%, n=34	50%, n=12	78%, n=9	85%, n=71	X^2 (3) 7.572, p=.056	-
CECAQ2 Closeness to Children (%)	67%, n=34	58%, n=12	78%, n=9	97%, n=71	X^2 (3) 22.229, p<.001	-
CECAQ2 Physical Abuse (%)	13%, n=31	33%, n=12	0%, n=9	14%, n=71	X^2 (3) 4.948, p=.176	-
CECAQ2 Sexual Abuse (%)	29%, n=31	42%, n=12	33%, n=9	13%, n=71	X^2 (3) 8.194, p=.042	-
BAS-RR: median (IQR)	16 (14-17), n=26	16 (14-18), n=11	16 (15.25-17), n=8	17 (16-18), n=57	H(3) =9.035, p= .029	-
BAS-FS: median (IQR)	9.75 (7-12), n=26	11 (7-12), n=11	9 (7-10.75), n=8	12 (10-13), n=57	H(3) =14.534, p= .002	AN<HC p= .001 BN=HC p= .229

	AN	BN	AN-Rec	HC	Test-statistic	Post-hoc
						AN-Rec<HC p=.009 AN=BN p=.441 AN=AN-Rec p=.591 BN=AN-Rec p= .272
BAS-D: median (IQR)	11 (9-13), n=26	10 (8-12), n=11	9.50 (8.25-11.75), n=8	12 (10-13), n=57	H(3) =4.722, p=.193	-
BIS: median (IQR)	26 (21-28), n=26	25 (22-28), n=11	26 (21-27.75), n=8	21 (19-24), n=57	H(3) =22.620, p< .001	AN>HC p< .001 BN>HC p= .007 AN-Rec>HC p=.020 AN=BN p=.883 AN=AN-Rec p=.921 BN=AN-Rec p=.968
OSS: median (IQR)	10 (9-12), n=34	8 (7-9), n=12	11 (10.50-12.50), n=9	11 (10-12), n=72	H(3) =17.296, p= .001	AN=HC p= .129 BN<HC p< .001 AN-Rec=HC p=.542 AN>BN p=.005 AN=AN-Rec p=.150 BN<AN-Rec p=.002

Note. Abbreviations. CECAQ: Childhood Experience of Care and Abuse; BAS: Behavioural Activation Scale; BIS: Behavioural Inhibition Scale; RR: Reward Responsivity; FS: Fun Seeking; D: Drive; OSS: Oslo Social Support Scale.

5.11.2. Dot-Probe task

Data concerning attentional processing were available for the total sample. Presented in Figure 11 and 12 are the results from the dot-probe. The attentional index scores are presented on the Y-axis and the individual groups are shown on the X-axis. As previously described in section 5.10.6., the attentional index score is calculated by subtracting the RT of the valid trials from the invalid trials (attentional index= invalid trials – valid trials). A positive attentional index score indicates that there is a positive bias, attention is directed to the probe which replaced the target picture, while a negative attentional score reflects that attention has been oriented away from the target picture.

5.11.2.1. Dot-Probe task: Attentional response to adult faces

Combined currently ill group compared to recovered AN and HC

Presented in Figure 11 are the mean and SEM attentional index scores for responses to adult faces. Attentional processing to adult displays of happiness and sadness was similar between groups (Group X Emotion interaction: F (3, 149) =1.139, p=.323) and including depression as a covariate did not change the main effect. Accuracy in identifying the probe stimulus was similar between groups for attention to happy (F(3, 151)=.215, p=.807) and sad expressions (F(151)=.317, p=.729). There was no significant difference on the task between clinical cases who were taking medication and those who were not.

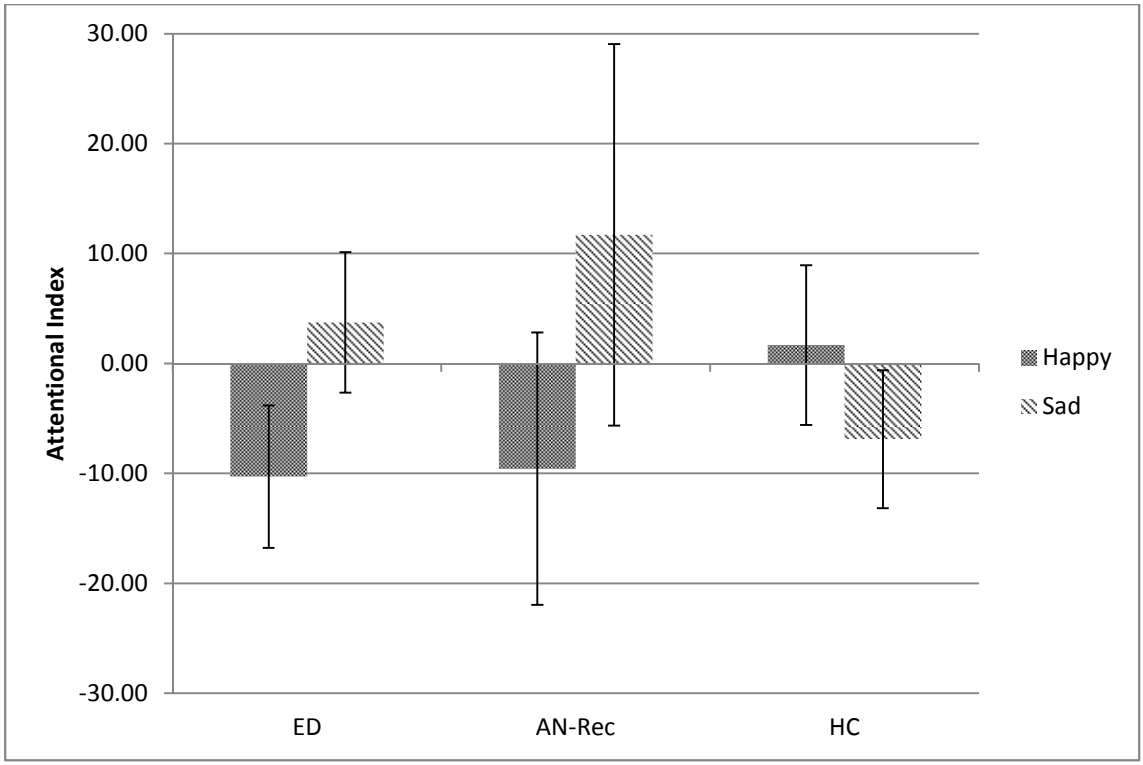

Figure 12. Attentional index mean (SEM) scores in response to adult happiness and sadness in women with current and past eating disorders versus healthy controls.

Subgroups

Presented in Figure 12 are the mean and SEM attentional index scores for the response to adult faces. The interaction between Group and Emotion was non-significant (Group X Emotion interaction: F (3, 146) =1.136, p=.337) and adjusting for depression did not change the main effect. Accuracy in identifying the probe stimulus was similar between groups for the happy (F(3, 151)=.174, p=.914) and sad expressions (F(3, 151)=.217, p=.885). There was no significant difference on the task between clinical cases who were taking medication and those who were not.

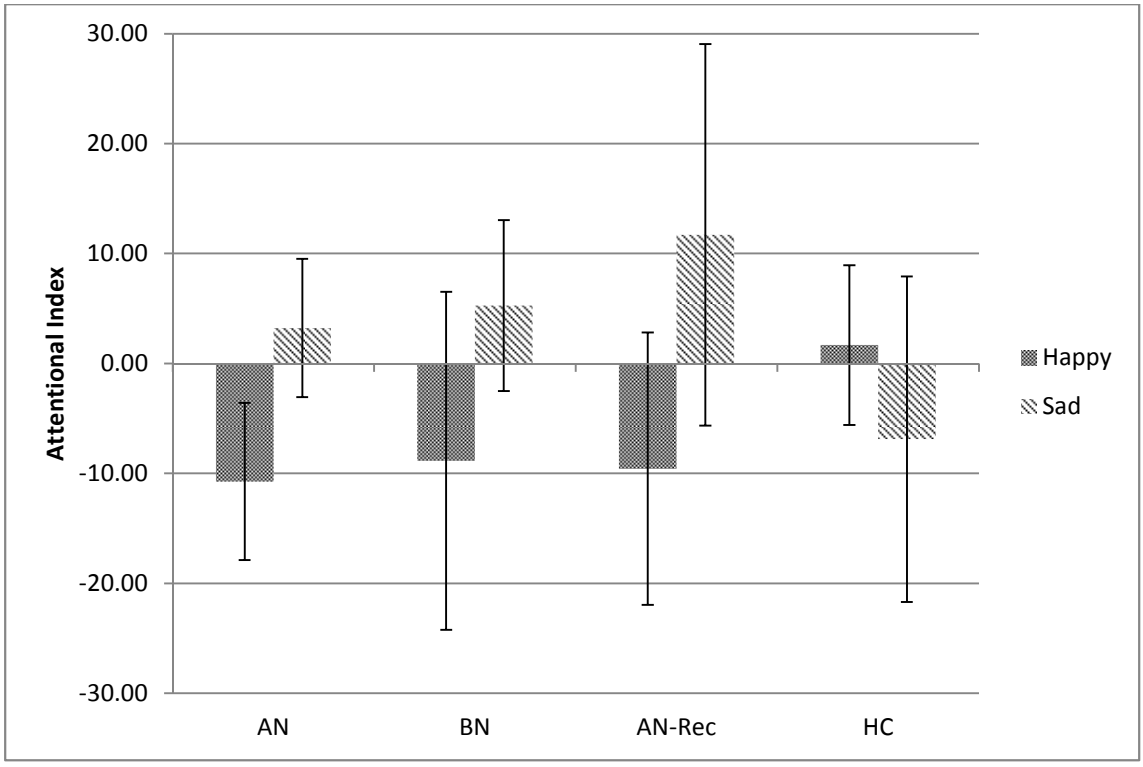

Figure 13. Attentional index mean (SEM) scores in response to adult faces in subgroups of women with a history of an eating disorder versus healthy controls.

5.11.2.2. Dot-Probe task: Attentional response to infant faces

Combined currently ill group compared to recovered AN and HC

Figure 13 presents the mean and SEM attentional index scores for those currently ill (AN and BN) compared to those who have recovered and HC. Attentional processing was similar between groups (Group X Emotion interaction: F (2, 148) =.611, p=.544). There was no significant difference between groups in accuracy at identifying the probe stimulus in happy (F(2, 151)=2.820, p=.063) and sad expression conditions (F(2, 151)=1.151, p=.319). Attentional processing was similar between those clinical cases who were taking medication and those who were not taking medication.

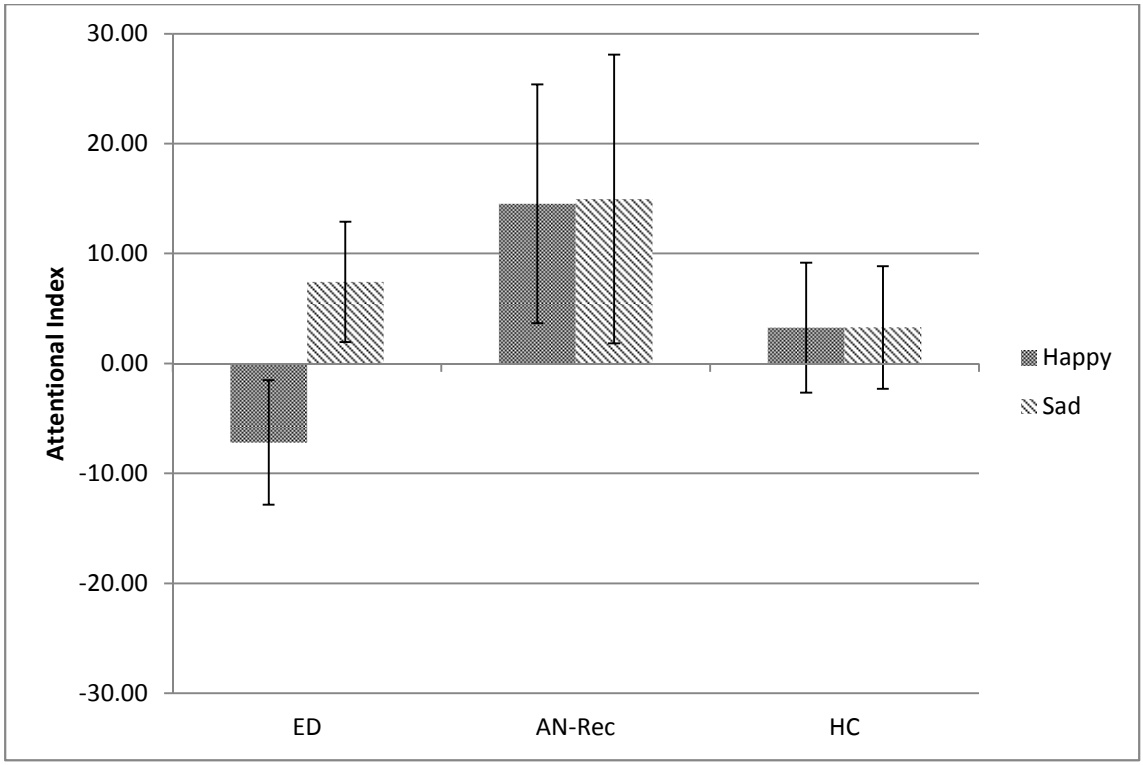

Figure 14. Attentional index mean (SEM) in response to infant happiness and sadness in women with current and past eating disorders versus healthy controls.

Subgroups

Figure 14 presents the mean and SEM attentional index scores for all four groups individually. Attentional processing to infant faces was similar between clinical cases and controls (Group X Emotion interaction: *F* (3, 147) =.404, *p*=.750), even after adjusting for depression. Accuracy in identifying the probe stimulus was similar between the groups for the happy infant expressions (F(3, 151)=2.611, *p*=.054) and for sad expressions (*F* (3, 151) =.946, *p*=.420). Individuals who were not taking medication paid significantly more attention to sad infant expressions compared to those who were taking medication (t(86) =3.022, p=.003), while there was no significant difference between cases who were taking medication and those who were not for attentional processing of happy expressions.

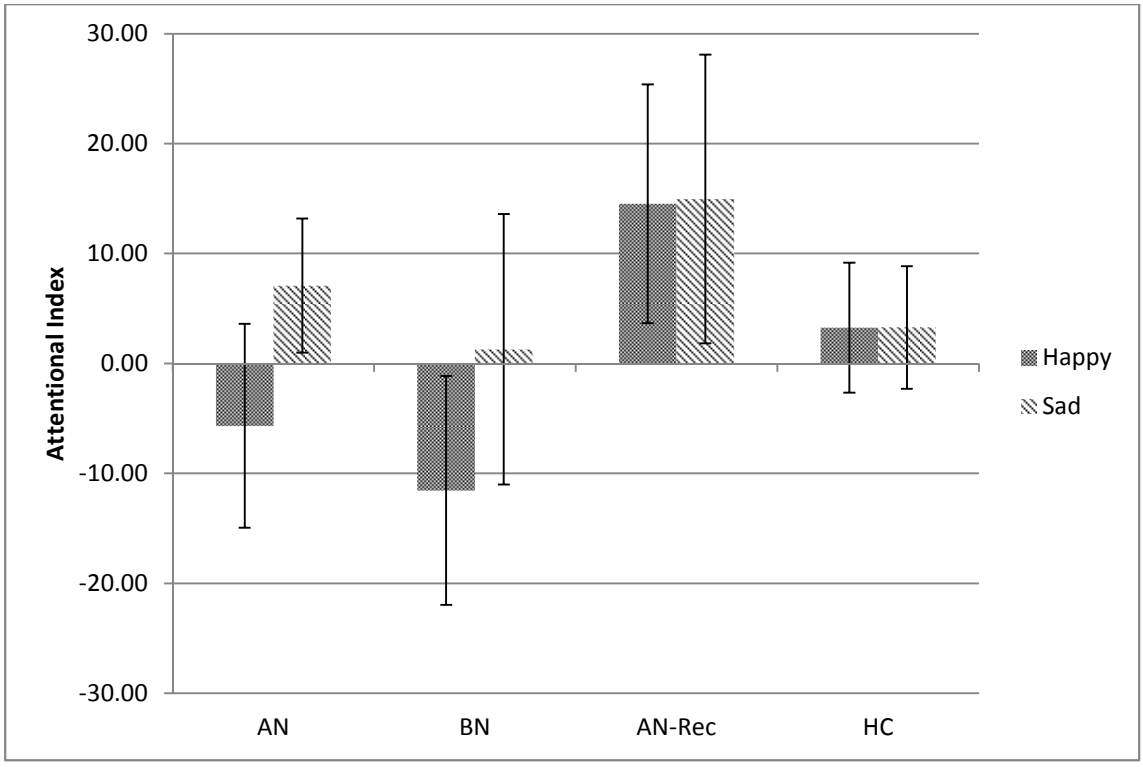

Figure 15. Attentional index mean (SEM) scores in response to infant faces in subgroups of women with a history of an eating disorder versus healthy controls.

5.11.2.3. Dot-Probe task: Comparison of attentional processing of adult and infant faces

Combined currently ill group compared to recovered AN and HC

The interaction between attentional response to adult and infant faces between groups was non-significant (Group X Type of Face interaction: F (2, 146) =.269, p=.765). Similarly the interaction between attentional response to adult and infant faces, emotion and group was non-significant (Group X Type of Face X Emotion interaction: F (2, 146) =.492, p=.612).

Subgroups

There was no significant interaction between attentional response to adult and infant faces according to subgroups (Group X Type of Face interaction: F (3, 145) =.209, p=.890). The interaction between attentional response to adult and infant faces, emotion and subgroups was found to be non-significant (Group X Type of Face X Emotion interaction: F (3, 145) =.326, p=.807).

5.11.3. Film Task

Data relating to the identification of others' emotions and subjective emotional reactivity were available for 88% of the sample. Data concerning facial mirroring and avoidance was available for

80% of the sample (due to technical difficulties with the camera and coding of videos where the participants face was not in shot/participants declined to be filmed).

Presented in Table 8 are the median and IQR for both the identification of others' emotion and subjective emotional reactivity. Figures 15-19 present the mean and SEM scores for Facial Mirroring (frequency of positive expression to Happiness; frequency of negative expression to Sadness and Frustration) and Facial Avoidance (counts of turning away from the screen displaying happiness, sadness and frustration).

Table 8. Identification of others' emotion and subjective emotional reactivity response to adults and infants displaying happiness, sadness and frustration in women with an eating disorder history versus healthy controls. (AN: Anorexia Nervosa; BN: Bulimia Nervosa; AN-Rec: Anorexia Nervosa Recovered; HC: Healthy Control).

	Emotion	AN	BN	AN-Rec	HC	Test statistic
Identification of others' emotion						
Adult						
	Happy	13 (9.5-15.5)	14 (12.5-15.5)	13 (8-16)	14 (13-16)	H(3) =5.054, p=.168
	Sad	11.50 (4.25-15.5)	11 (7-15.5)	12 (4-14.50)	13 (6.5-17)	H(3) =1.377, p=.711
	Frustrated	22 (14-29)	20 (16-27.5)	22.50 (16.5-30.5)	24 (20-29)	H(3) =3.195, p=.362
Infant						
	Happy	13 (10-15)	14 (14-16.5)	13 (8.5-16)	15 (14-16)	H(3) =11.703, p=.008
	Sad	13 (7-20)	13 (9.5-16)	7 (3.5-14.50)	12 (7-16)	H(3) =3.984, p=.263
	Frustrated	17 (12-23)	16 (11-23)	12 (5-20)	18 (12-24)	H(3) =3.464, p=.325
Subjective emotional reactivity						
Adult						
	Happy	5 (3-15)	7 (2.5-12.75)	11 (2.5-23.50)	10 (6-14.5)	H(3) =3.87, p=.275
	Sad	4 (2-7.75)	4 (1-6.75)	4.5 (0.25-7.75)	3 (1-6.5)	H(3) =1.238, p=.774
	Frustrated	9 (4-13.5)	4 (1-13.25)	4 (3-10)	7 (4-13)	H(3) =2.582, p=.461
Infant						
	Happy	11 (7-16)	13 (6-18)	10 (4-16.5)	13 (8-19)	H(3) =2.239, p=.524
	Sad	6 (3-11.25)	5 (1-12)	3 (0.00-7.5)	3 (1-5)	H(3) =14.652, p=.002
	Frustrated	8 (3-17)	5 (1.5-12)	6 (1.5-11)	5 (3-10)	H(3) =3.814, p=.282

5.11.3.1. Film Task: The identification of emotions displayed by adult faces

Combined currently ill group compared to recovered AN and HC

The identification of happiness (H(2)=3.930, p=.140), sadness (H(2)=3.193, p=.203) and frustration (H(2)=1.253, p=.534) were similar between those currently ill, recovered and HC. Participants who were taking medication and those who were not taking medication had similar identification ratings (Happy: U=123.800, p=.132; Sad: U=164.000, p=.538; Frustrated U=186.000, p=.864).

Subgroups

There was no significant difference between the groups in their ratings of happiness, sadness and frustration. Participants who were taking medication and those who were not taking medication had similar ratings (Happy: U=123.800, p=.132; Sad: U=164.000, p=.538; Frustrated U=186.000, p=.864).

5.11.3.2. Film Task: The identification of emotions displayed by infant faces

Combined currently ill group compared to recovered AN and HC

The identification of infant happiness (H(2)=7.195, p=.027) differed significantly between groups (see below for subgroup analyses). There was no significant difference between ratings of sadness (H(2)=3.983, p=.137) and frustration (H(2)=3.379, p=.185). There was no significant difference in ratings from participants who were taking medication and those who were not taking medication.

Subgroups

Compared to HC, women with AN rated infant happiness as less intense than HC did (U=768.000, p=.001, d=.33). No other post-hoc comparisons were significant. There was no significant difference between those who were taking medication and those who were not taking medication.

5.11.3.3. Film Task: Comparison of the identification of emotions displayed by adults and infants

Combined currently ill group compared to recovered AN and HC

The interaction between the identification of adult and infant displays of emotion and groups was non-significant (Group X Type of Face interaction: F (2, 125) =1.988, p=.141). There was no significant interaction between the identification of adult and infant displays, group and emotion (Group X Type of Face X Emotion interaction: F (4, 250) =1.584, p=.179).

Subgroups

The interaction between the identification of adult and infant displays of emotion and groups was non-significant (Group X Type of Face interaction: F (3, 124) =1.335, p=.266). Also there was no significant interaction between group, emotion displayed by adult and infant and type of face (Group X Type of Face X Emotion interaction: F (6, 248) =1.242, p=.285).

5.11.3.4. Film Task: The subjective emotional reactivity in response to adult faces

Combined currently ill group compared to recovered AN and HC

Participants had similar subjective emotional reactivity ratings to adult displays of happiness (H(2)=3.749, p=.153), sadness (H(2)=1.171, p=.557) or frustration (H(2)=1.042, p=.594). There was no significant difference on the task between clinical cases who were taking medication and those who were not.

Subgroups

Participants were similar in their subjective emotional reactivity ratings to adult displays of happiness, sadness and frustration. There was no difference in self-ratings from participants who were taking medication and those who were not taking medication.

5.11.3.5. Film Task: Subjective emotional reactivity in response to infant faces

Combined currently ill group compared to recovered AN and HC

There was a significant group difference in subjective emotional reactivity to infant sadness (H(2)=13.456, p=.001) (see below for subgroup analyses). There were no other group differences (happiness: (H(2)=2.161, p=.339; frustration: H(2)=1.750, p=.417). There was no significant difference on the task between clinical cases who were taking medication and those who were not.

Subgroups

Women with AN rated subjective emotional reactivity as significantly higher in negative affect than HC (U=653.000, p<.001, d=.24). No other post-hoc comparisons were significant. There were no significant differences in the subjective ratings between those who were taking medication and those who were not taking medication.

5.11.3.6. Film Task: Comparison of the subjective emotional reactivity to emotions displayed by adults and infants

Combined currently ill group compared to recovered AN and HC

The interaction between subjective emotional reactivity to adult and infant faces and group was found to be non-significant (Group X Type of Face interaction: F (2, 125) =2.111, p=.125). Also there was no significant interaction to subjective emotional reactivity to adult and infant faces, group and emotion (Group X Type of Face X Emotion interaction: F (4, 250) =1.779, p=.134).

Subgroups

The interaction between the identification of adult and infant displays of emotion and groups was non-significant (Group X Type of Face interaction: F (3, 124) =1.398, p=.247). There was no significant interaction between group, emotion displayed by adult and infant and type of face (Group X Type of Face X Emotion interaction: F (6, 248) =1.506, p=.176).

5.11.3.7. Film Task: Facial mirroring towards adult displays of emotion

The facial mirroring scores are presented on the Y-axis and the individual groups are shown on the X-axis. The facial mirroring scores are based on the frequency of expression; higher scores indicate a higher frequency of emotional expression towards the film clip.

Combined currently ill group compared to recovered AN and HC

There was a significant effect of facial mirroring of happiness (H(3) =16.263, p<.001). Those currently ill had significantly less facial mirroring to happiness than HC (U=420.00, p=.712, d=.69). There was no significant difference in facial mirroring between participants who were taking medication and those who were not.

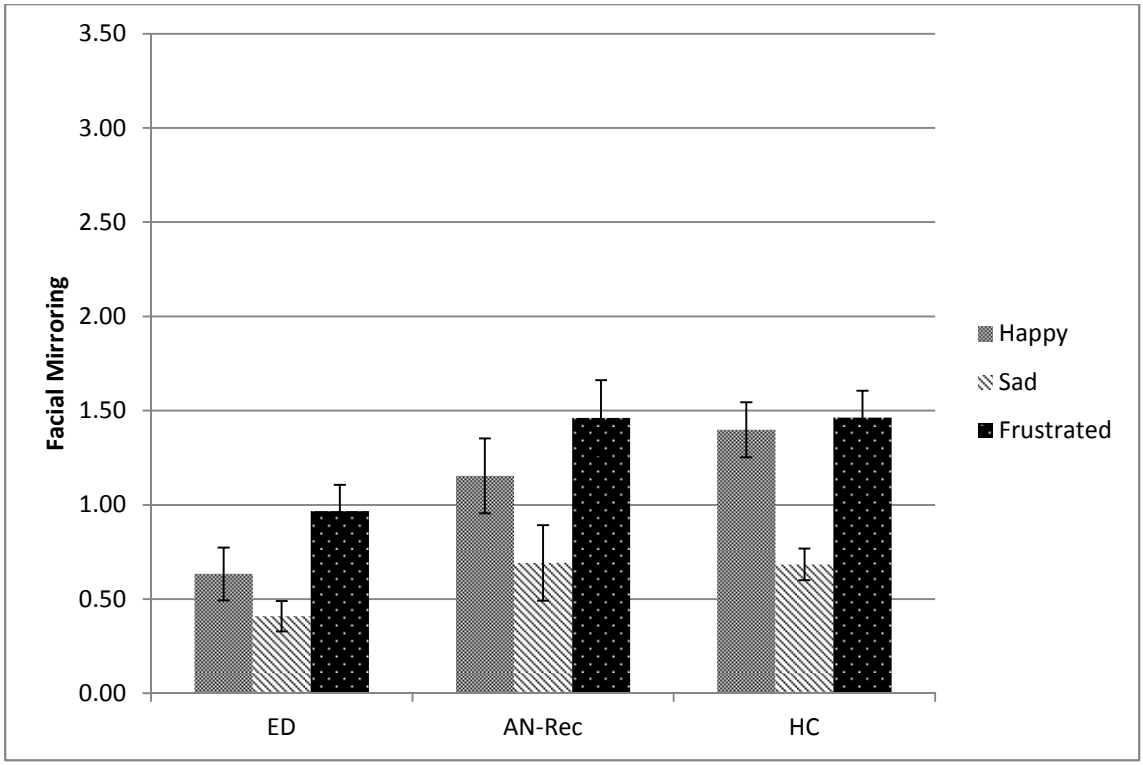

Figure 16. Facial mirroring mean scores (SEM) to adult displays of happiness, sadness and frustration in women with current and past eating disorders versus healthy controls.

Subgroups

There was a significant effect of group in facial mirroring of happiness ($H(3) = 16.923$, $p = .001$). Women with AN had less facial mirroring of happiness compared to HC ($U = 588.500$, $p < .001$, $d = .79$) and those recovered ($U = 104.000$, $p = .006$, $d = .81$). In other words women currently ill with AN were less facially expressive in response to happiness than women who had recovered or who have never experienced an ED. No other post-hoc tests were significant and the ES compared to HC ranged from negligible to moderate (Happy: BN d=.43, AN-Rec d=.23; Sad: AN d=.37, BN=.48, AN-Rec d=.01; Frustrated: AN d=.44, BN d=.47, AN-Rec d=.00). There was no significant difference in facial mirroring between participants who were taking medication and those who were not.

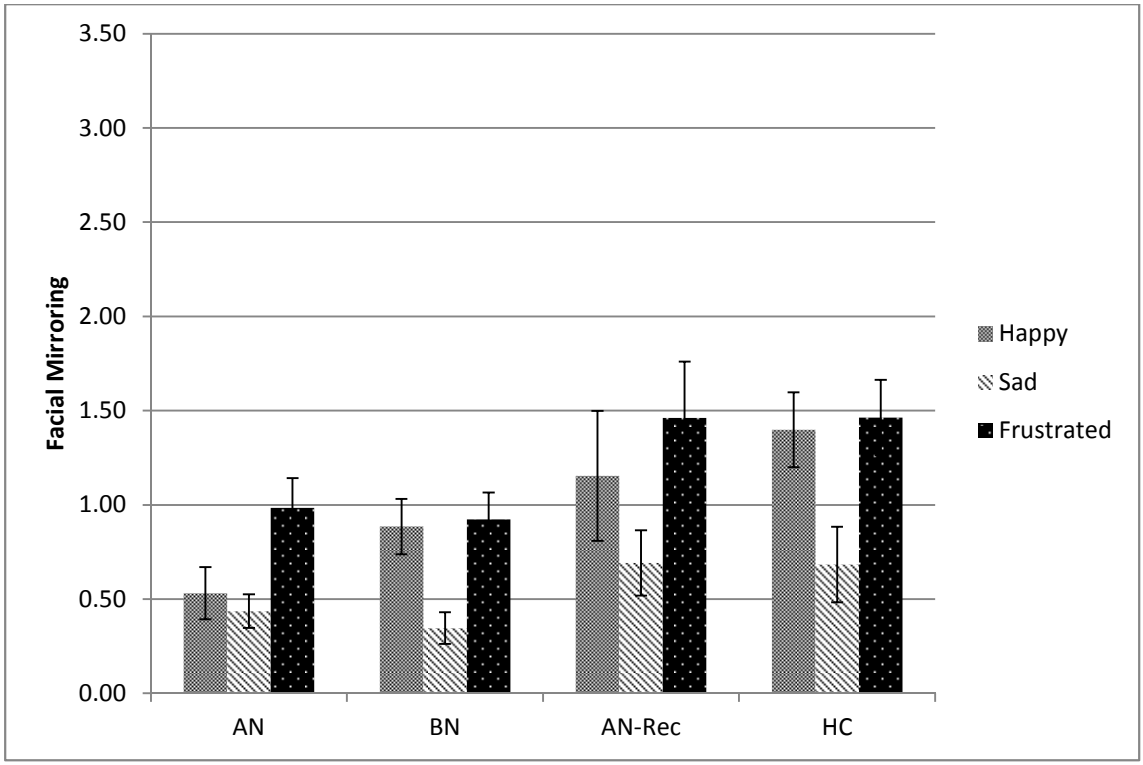

Figure 17. Facial mirroring mean scores (SEM) to adult displays of happiness, sadness and frustration in women with an eating disorder history versus healthy controls.

5.11.3.8. Film Task: Facial mirroring towards infant displays of emotion

Combined currently ill group compared to recovered AN and HC

There was an overall significant effect of facial mirroring of happiness ($H(3) = 25.981$, $p < .001$). Those currently ill had significantly less facial mirroring to happiness than HC with a large ES ($U = 682.500$, $p < .001$, $d = .97$). Those who were currently ill and those who had recovered from an ED had similar levels of facial expressivity to happiness ($U = 206.500$, $p = .102$, $d = .49$). No other post-hoc test was significant. There was no significant difference in facial mirroring between participants who were taking medication and those who were not.

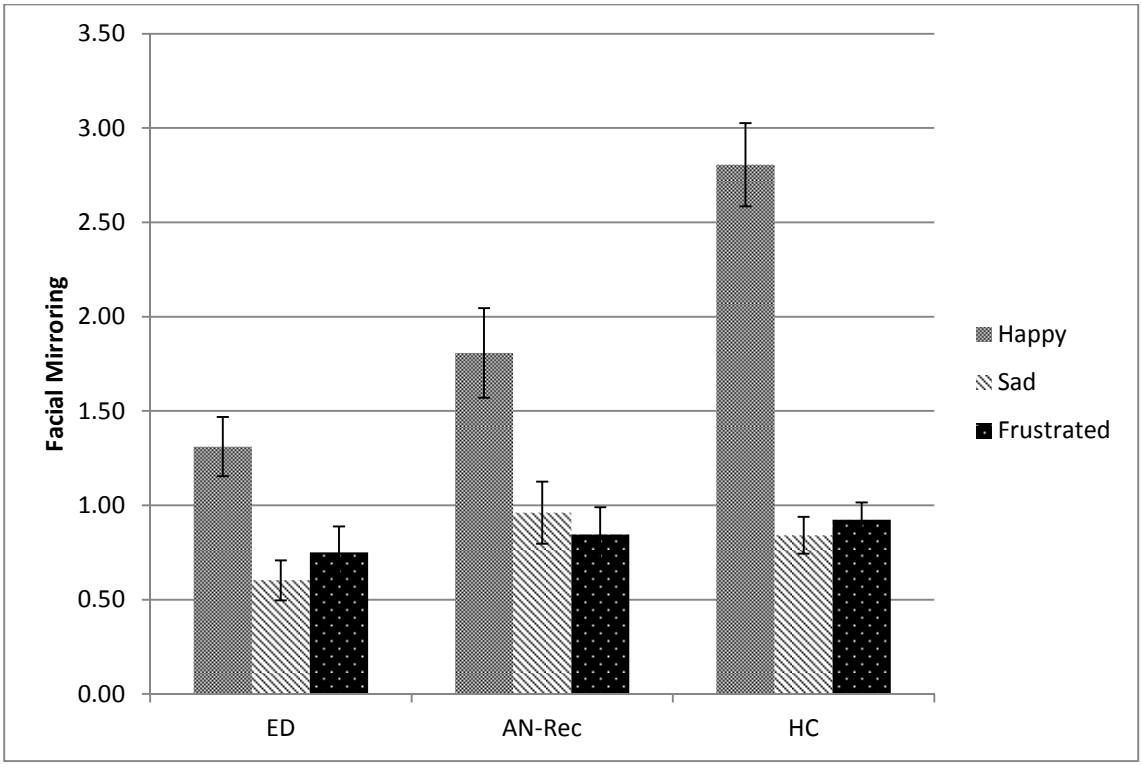

Figure 18. Facial mirroring mean scores (SEM) to infants displaying happiness, sadness and frustration in women with an eating disorder history versus healthy controls.

Subgroups

Facial mirroring of infant happiness differed significantly between groups ($H(3) = 26.039$, $p < .001$). Women currently ill with AN ($U = 482.500$, $p < .001$, $d = .99$) and BN ($U = 200.000$, $p = .005$, $d = .77$) showed significantly less facial mirroring of happiness compared to HC. Post-hoc tests examining response to sadness and frustration were non-significant. The ES compared to HC ranged from small to moderate (Happy: AN-Rec $d = .59$; Sad: AN $d = .31$, BN $= .31$, AN-Rec $d = .16$; Frustrated: AN $d = .21$, BN $d = .23$, AN-Rec $d = .10$). There was no significant difference in facial mirroring between participants who were taking medication and those who were not.

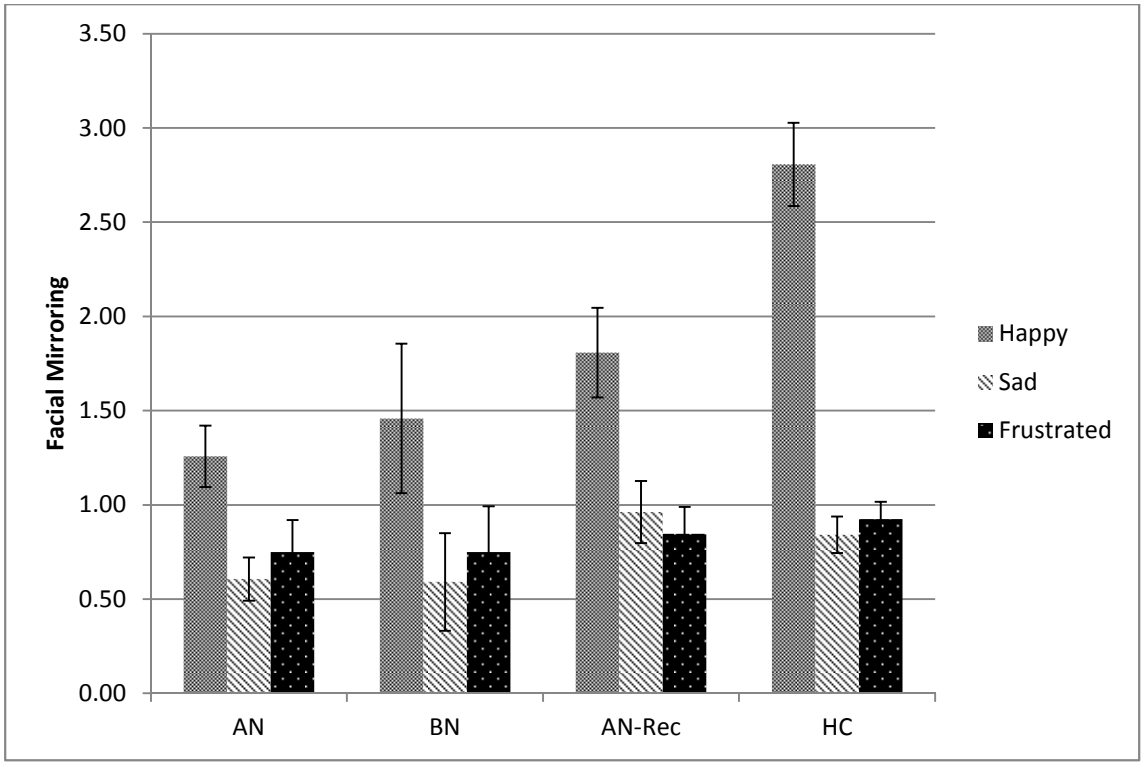

Figure 19. Facial mirroring mean scores (SEM) to infants displaying happiness, sadness and frustration in women with current and past eating disorders versus healthy controls.

5.11.3.9. Film Task: Comparison of facial mirroring to emotions displayed by adults and infants

Combined currently ill group compared to recovered AN and HC

There was a non-significant interaction between facial mirroring to adult and infant faces by group (Group X Type of Face interaction: F (2, 109) =0.832, p=.438). A significant interaction was found between facial mirroring to adult and infant faces, group and emotion (Group X Type of Face X Emotion interaction: F (4, 218) =3.740, p=.006).

Subgroups

The interaction between facial mirroring to adult and infant faces by subgroup was non-significant (Group X Type of Face interaction: F (3, 108) =.652, p=.583). However there was a significant interaction between facial mirroring to adult and infant faces, subgroup and emotion (Group X Type of Face X Emotion interaction: F (6, 216) =2.547, p=.021).

5.11.3.10. Film Task: Facial avoidance in response to adult displays of emotion

The facial avoidance scores are presented on the Y-axis and the individual groups are shown on the X-axis. The facial avoidance scores are based on the frequency of looking away from the film clip; higher scores indicate a higher frequency of looking away from the film clip presented.

Combined currently ill group compared to recovered AN and HC

Two significant group differences were found in avoidance of happiness ($H(2) = 16.263$, $p < .001$) and of frustration ($H(2) = 194$, $p = .004$). Compared to healthy women, women currently ill had significantly more avoidance of adult happiness ($U = 1093.5000$, $p < .001$, $d = .47$) and frustration ($U = 1095.500$, $p < .001$, $d = .50$). There was no significant difference in facial avoidance between participants who were taking medication and those who were not.

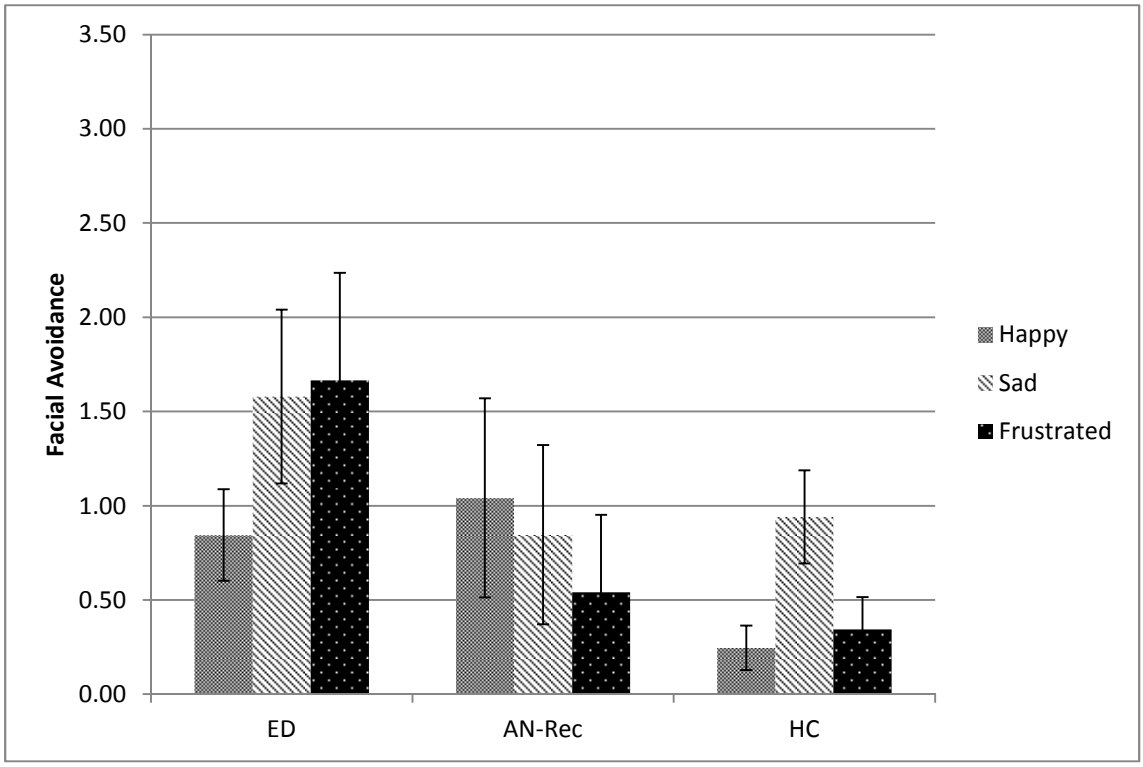

Figure 20. Facial avoidance mean scores (SEM) towards adult displays of happiness, sadness and frustration in women with eating disorders versus healthy controls.

Subgroups

There was an overall group difference in avoidance of happiness (H(3) =15.965, p=.001) and of frustration (H(3) =12.121, p=.007). All of the clinical cases turned away more from displays of happiness compared to the reference group (AN: U=827.000, p=.004, d=.50; BN: U=266.500, p=.001, d=.38; AN-Rec: U=260.500, p=.001, d=.70). Women with AN also turned away more from displays of frustration compared to healthy women (U=731.000, p=.001, d=.58). No other post-hoc tests were significant and the ES compared to HC ranged from negligible to moderate (Sad: AN d=.32, BN d=.12, AN-Rec d=.04; Frustrated: BN d=.60, AN-Rec d=.02). There was no significant difference in facial avoidance between participants who were taking medication and those who were not.

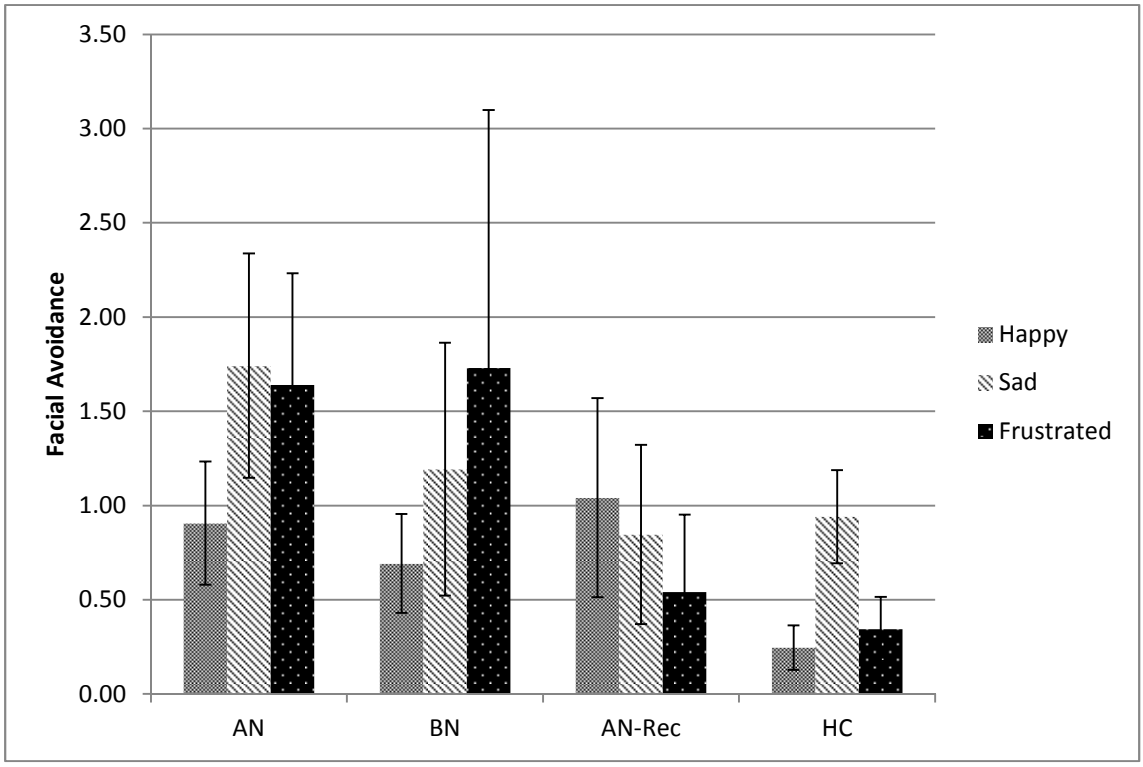

Figure 21. Facial avoidance mean scores (SEM) towards adult displays of happiness, sadness and frustration in women with an eating disorder history versus healthy controls.

5.11.3.11. Film Task: Facial avoidance of infant displays of emotion

Combined currently ill group compared to recovered AN and HC

A marginally significant group difference was found in facial avoidance of infant frustration (H(2) =6.168, p=.046). Compared to healthy women, women currently ill looked away more from infants displaying frustration (U=1087.500, p=.015, d=.44). No other post-hoc tests were significant and the

ES compared to HC were small (Happy: ED d=.32; Sad: ED d=.22).There were no significant differences in facial avoidance of happiness and sadness between participants who were taking medication and those who were not.

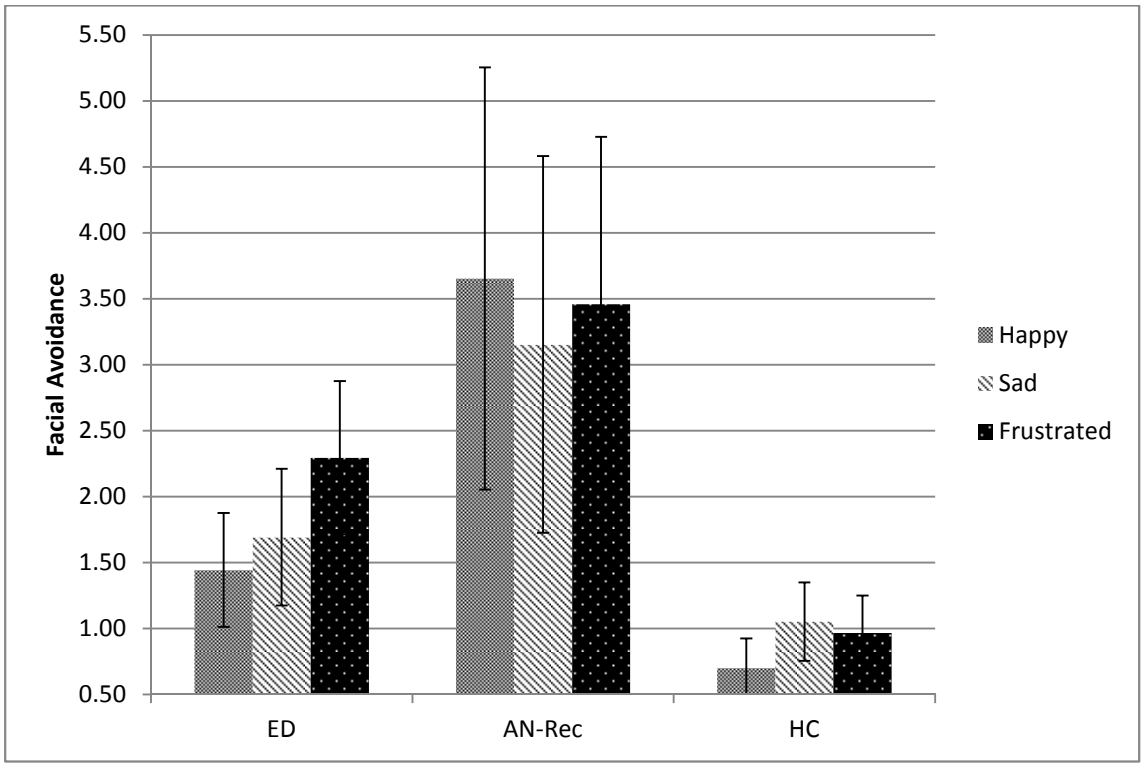

Figure 22. Facial avoidance mean scores (SEM) towards infant displays of happiness, sadness and frustration in women with an eating disorder history versus healthy controls.

Subgroups

There was a marginally significant group difference in facial avoidance of infants displaying frustration (H(3) =6.536, p=.088). Women with AN looked away more from a frustrated infant than HC (U=755.500, p=.013, d=.46). No other post-hoc tests were significant and the ES compared to HC ranged from small to moderate (Happy: AN d=.30, BN d=.45, AN-Rec d=1.05; Sad: AN d=.14, BN d=.50, AN-Rec d=.70; Frustrated: BN d=.51, AN-Rec d=.90). Women with ED who were not taking medication showed more facial avoidance of infant sadness than those taking medication (U=91.000, p=.008) and there was no significant group difference in response to infant happiness or sadness between women taking medication and those not taking medication.

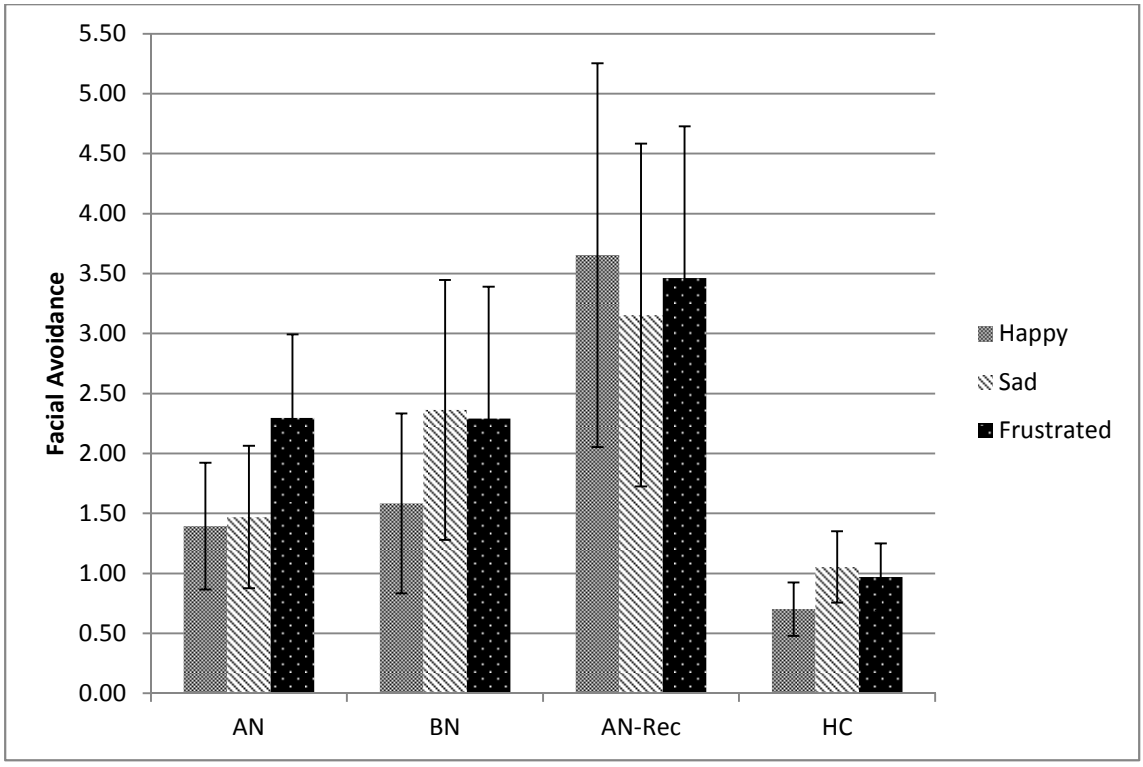

Figure 23. Facial avoidance mean scores (SEM) towards infant happiness, sadness and frustration in women with current and past eating disorders versus healthy controls.

5.11.3.12. Film Task: Comparison of facial avoidance to emotions displayed by adults and infants

Combined currently ill group compared to recovered AN and HC

There was a significant interaction between the facial avoidance of adult and infant displays of emotion and groups (Group X Type of Face interaction: F (2, 108) =5.156, p=.007). But the interaction between facial avoidance of adult and infant displays of emotion, groups and emotion was non-significant (Group X Type of Face X Emotion interaction: F (4, 216) =.856, p=.492).

Subgroups

There was a significant interaction between facial avoidance of adult and infant displays of emotion and subgroups (Group X Type of Face interaction: F (3, 107) =3.558, p=.017). However there was a non-significant interaction between facial avoidance of adult and infant displays of emotion, subgroups and emotion (Group X Type of Face X Emotion interaction: F (6, 214) =1.171, p=.323).

5.11.4. Correlations between self-report variables and attentional processing and facial expression

To adjust for multiple-testing a p value of less than .003 was required according to the Bonferroni correction. Chronicity and severity of ED was related to facial mirroring of infant faces, a significant

negative correlation was found between length of illness and facial mirroring of infant happiness (r=-.484, p<.001) and between global EDE-Q score and facial mirroring of infant sadness (r=-.305, p=.001). An *a posteriori* test of BMI and facial mirroring towards happiness was non-significant.

Depression negatively correlated with facial mirroring of adult happiness (r=-.315, p=.001). There was a marginally significant negative association between depression and facial mirroring of infant happiness (r=-.278, p=.003), in other words facial expressivity to infant happiness decreased as depression increased.

Percieved level of social support from others was negatively associated with avoidance of adult happiness (r=-.303, p=.001), in other words social support decreased as facial expressivity towards happiness decreased. Approach and avoidance was not correlated with either attentional processing or facial response.

Following the procedure of Cardi and colleagues (Cardi et al., 2012) analysis, a composite score of 'Early Adversity' was calculated by combining the items from the CECAQ2: 'Separation from parents', 'no closeness to children' and 'Sexual abuse'. No significant correlations were found between early adversity and attentional processing – or of facial mirroring and avoidance. Neither 'Separation from parents', 'no closeness to children' or 'Sexual abuse' independently predicted emotional processing outcomes.

5.12. Discussion

5.12.1. Aim of study

The aim of this study was to examine emotional reactivity to adult and infant faces expressing basic positive and negative emotions (i.e. happiness, sadness, frustration) in women with a history of an ED compared to healthy volunteers, using explicit (i.e. self-reports) and implicit measures (dot probe and facial expression recording).

5.13. Attentional processing

Three hypotheses were proposed in relation to attentional processing in response to adult and infant displays of happiness and sadness. These hypotheses were unsupported, as (a) the groups were found to be similar in their attentional response towards happiness, sadness and neutral adult and infant displays; (b) there were no between group differences in patterns of attentional deployment; (c) attentional deployment was not predicted by childhood adversity and was not

found to be a correlate of either social support, approach avoidance behaviour or depression. Also attentional processing did not vary according to whether the emotion was displayed by either an adult or an infant.

In the current study we failed to find statistically significant differences in attentional processing between people with ED and HC. These findings were unexpected as previous research indicates that people with ED show a tendency to pay more attention social threat and pay less attention to social reward (Cardi et al., 2014; Cardi et al., 2012; Cserjesi et al., 2011; Harrison, Sullivan, et al., 2010; Harrison, Tchanturia, et al., 2010). A recent study reported that smiling faces did not produce strong attentional response in either patients with ED or HC in a Korean sample (Kim et al., 2014), this may be related to issues with power, sensitivity of timing or salience of stimuli.

There may be several explanations for the null findings in the current study. The lack of significant findings could be related to the study being considerably underpowered. According to the power calculation provided, 382 participants were required per group and due to missing data tests were performed on small group sizes. Selective attention to basic positive and negative expressions appears to be intact, thus people with ED and those who have recovered do not show general weaknesses in the attentional processing towards all socio-emotional stimuli. The emotions happiness and sadness may not be as salient/arousing for people with ED as others used previously (e.g. threatening images such as anger, Harrison, Sullivan, et al., 2010). Micro differences in emotional expressions (e.g. *happiness* in the current study versus *warmth* in Cardi et al., 2012) may explain why people with ED show different styles of attentional processing across a range of emotional categories.

Attentional processing anomalies to happiness and sadness have been found in other psychiatric conditions (e.g. Gotlib et al., 2004; Bourke, Douglas & Porter, 2010). Further these anomalies have been found towards emotional displays by infants, for example non-depressed pregnant women have been reported to show an engagement bias towards distressed infant faces presented at 500ms, while those with depression disengaged more quickly from the images (Pearson, Lightman, & Evans, 2011). Exploring the differences in maternal and menstrual status and attentional processing would have been important in the current study.

5.14. Identification of Others' Emotions

We had expected that women currently ill with an ED would be less likely to be able to accurately identify others' emotions, rating them as less intense, compared to individuals who had recovered

from an ED or HC (e.g. Oldershaw et al., 2009). This hypothesis was supported to a marginal extent, as women currently ill with AN were found to rated infant happiness as less intense when compared to ratings made by HC. This finding is consistent with the abnormal reports of social anhedonia in the condition (Tchanturia, Davies, Harrison et al., 2012).

The difficulties in emotional response to infant faces in the current study are consistent with those reported in depression and GAD. Women with depression were less able to correctly identify infant happiness and women with GAD identified infant happy faces at a lower intensity than healthy women (Arteche et al., 2011). Women with postnatal depression tended to rate negative infant faces more negatively than healthy volunteers; women with postnatal GAD rated infant faces similarly to controls (Stein et al., 2010). Weaknesses in the identification of infant happiness appear to be common to both AN, depression and GAD. It would be important to explore whether depression and anxiety were responsible for the weakness in the identification of infant happiness in AN by comparing groups of those with high and low depression and anxiety. The identification of adult happiness was not impaired in women with AN, thus the apparent weakness in the identification of infant happiness may be indicate a specific rather than a general difficulty. Of note is that these impairments in the identification of infant's happiness were not apparent in those that had recovered from AN, suggesting that the deficit may be related to the effects of starvation and improve with weight restoration.

5.15. Subjective Emotional Reactivity

We had anticipated that women currently ill with an ED would report lower subjective emotional reactivity to happy, sad and frustrated displays (e.g. Davies et al., 2011). This hypothesis was unsupported, unexpectedly however women with AN reported higher subjective emotional reactivity to sad displays by infants. This finding was in the opposite direction to that which was initially predicted. Earlier work had reported that people with AN had similar levels of subjective negative reactivity to a tragic film clip (Davies et al., 2011). Typically people with AN have been reported to perceive negative affective photographs as more intense (Nandrino et al., 2012). The stronger subjective emotional reactivity to infant sadness may indicate a greater ability to empathise with sadness. This is in line with reports showing that vicarious distress to others suffering (Beadle, Paradiso, Salerno & McCormick, 2013) and normal levels of affective empathy in AN (Calderoni, Fantozzi, Maestro, Brunori, Narzisi, Balboni & Muratori, 2013). Our finding would suggest that there are not general impairments in socio-emotional functioning in AN. Of interest is that this strength

was not found in those who had recovered, thus appears to be a state rather than a trait of the illness.

5.16. Facial Expressions

We had predicted that women currently ill and recovered from an ED would have less facial expressions and more instances of avoidance in response to adults displaying happiness, sadness and frustration in film clips compared to HC (Davies et al., 2011; Rhind et al., submitted). This hypothesis was partly supported as we found that women currently ill had a reduced frequency of facial mirroring while viewing an adult and infant displaying happiness in a film clip compared to HC. Women who had recovered from AN did not differ from HC. Chronicity and severity of ED was related to facial mirroring of infant faces. Those currently ill turned away more from displays of adult and infant happiness and frustration compared to HC. Also we had expected that facial mirroring and avoidance would be predicted by childhood adversity (Gibb, Schofield, & Coles, 2009). This part of the hypotheses was not supported. In line with our expectations, perceived social support (Cacioppo & Hawkley, 2009) and depression (Braun, Sunday, & Halmi, 1994; Kessler et al., 2012) were all correlates of facial expression. Percieved level of social support from others was negatively associated with avoidance of adult happiness, which might be a potential mechanism to explain decreased friendship networks in ED. Depression negatively correlated with facial mirroring of adult and infant happiness. Approach and avoidance was not correlated with facial expression.

The finding that women with AN show less facial mirroring is consistent with earlier reports. Both adults and adolescents with AN were less facially expressive when watching comic and tragic film clips (Davies et al., 2011; Rhind et al., submitted). Also adults with AN had fewer expressions of joy when playing a video game (Claes et al., 2012). This appears to be an effect of the ill state as it was not seen in people who had recovered. Diminished facial expression has been reported in other psychiatric conditions, such as in depression (e.g. Renneberg, Heyn, Gebhard, & Bachmann, 2005; Wexler, Levenson, Warrenburg, & Price, 1994; Sloan, Strauss, & Wisner, 2001; Schwartz, Fair, Salt, Mandel, & Klerman, 1976; Trémeau et al., 2005) BPD, (Matzke, Herpertz, Berger, Fleischer, & Domes, 2013) and schizophrenia (Gur et al., 2006). The low facial frequency of facial mirroring to happiness may be related to social anhedonia (Tchanturia et al., 2012). Interpersonal matching of expression during social interactions is important for engendering affiliation (Rogers & Williams, 2006).

Those currently ill turned away more often from displays of adult and infant happiness and frustration compared to HC. This behavioural feature is consistent with findings from earlier studies

which show that people with AN turn away more frequently than HC (Davies et al., 2011; Rhind et al., submitted). The increased tendency for those with ED to turn away while viewing emotional stimuli is in line with other studies examining emotional avoidance in AN (Wildes et al., 2010; Oldershaw et al., 2012). Maladaptive core beliefs about the value of experiencing emotions (Corstorphine, 2006; Oldershaw et al., 2012) may be related to this behavioural feature.

5.17. Strengths and Limitations

5.17.1. Strengths

The main strength of this study was the number of clinical groups, which allowed for the comparison of between diagnostic groups. In particular, the inclusion of the recovered group allowed for comparison of state and trait differences, although there were caveats to this discussed in the limitation section. The second advantage of this study was the use of ecologically valid stimuli, which allowed for the understanding of the processing of discrete emotions. The third advantage of this study was the use of mixed experimental methods, including those with behavioural outcomes. This reduced the biases associated with completing self-report measures (e.g. recall bias). The fourth advantage of this study is the comparison of responses to adult and infant stimuli which allows for a more specific understanding of where the strengths and weaknesses of social processing in ED lie.

5.17.2. Limitations

This study had a number of shortcomings. The first limitation was related to missing data. There were missing data on this study mainly due to technical difficulties with video recording, but also with low completion rate of questionnaires. The number of missing subjects limited the ability to test models. Both of these shortcomings might have influenced the power of the study. The power calculation estimated that more than the number of participants recruited were needed per group, therefore all three of the case groups were underpowered, and within that missing data, might have had implications of the pattern of findings found in this study.

The second limitation concerns the sample of participants. There were more cases with a diagnosis of AN than there were of BN, the overrepresentation of those with AN may have confounded results, especially in analyses where the groups were combined. It will be important to increase the proportion of those with BN to equal that of AN to explore further group similarities and differences in socio-emotional processing. Also all of the recovered participants were AN. This might have had implications for the interpretation of the findings when comparing analysis of those with current and

past ED, where clinical characteristics may be markedly different. Also there were insufficient data available concerning maternal or menstrual status. Since pregnant women have been reported to show an engagement bias towards distressed infant faces (Pearson, Lightman, & Evans, 2011) it may be apt to explore further the implact of maternal status on the response to emotions.

Thirdly, despite the use of ecologically valid stimuli, there may have been shortcomings in terms of the tasks used. The failure to find significant between-group differences in attentional processing may be due to order effects and the stimulus exposure time employed. The tasks were presented in a fixed order, adults followed by infants, and were not counterbalanced increasing the likelihood of order effects. Studies with depressed samples often fail to find differences on attentional tasks when stimuli are displayed during *pre-conscious* times (e.g. 500-750ms) (Mathews, Ridgeway, & Williamson, 1996; Mogg, Bradley, & Williams, 1995). Attention to negative words has been associated with longer (e.g. 1000ms) *post-conscious* exposure times in depression (Donaldson, Lam, & Mathews, 2007). It is possible that in the current study selective attentional maintenance or disengagement was being assessed rather than attentional bias as a result of the long exposure time. This concern could be addressed in future studies by including both short and long exposure times to full elucidate the pattern of attentional processing to happy and sad faces in ED. Also the monitoring of eye movements or shift gazes during task (e.g. Mogg et al., 2003) would be a direct measure of maintenance or disengagement of attention. Also it is possible that there were issues surrounding the salience of the picture stimuli used. Compared to those used in other studies (e.g. threatening images such as anger; Harrison, Sullivan, et al., 2010), the emotions happiness and sadness may not be as salient/arousing thus not producing as strong as an effect on attentional processing.

Additionally there were various shortcomings with the film task employed. The film clips were only matched on features such as length and discrete emotion, thus other factors which were not controlled for (e.g. ages/genders of person shown) may have played a role in the responses found. This limitation could have been overcome by using a validated set of film-clips (e.g. Gross & Levenson, 1997). The use of only one film clip per emotion, compared to 64 trials in the dot-probe task, lessens the reliability of the findings from the film task. The speed that participants took to rate the film clips was not measured, this limitation prevented the investigation of delays in emotional response.

5.17.3. Future work

Future work is required to address the findings from the current study in relation to the limitations mentioned above. In particular larger sample sizes are needed to determine whether the null findings in the current study were due to lack of power or a lack of effect. It will be important to include a sample with patients recovered from BN, as a shortcoming of the study is that only those recovered from AN were compared to those with acute AN and BN. Given that the literature suggests that maternal response is important, it may be appropriate to examine these measures in mothers with ED to consider the impact of maternal status on social-emotional processing of infant faces especially – or with their own infant. It will be important to explore the rewarding nature of infant faces in people with ED.

5.18. Clinical Implications

There are several clinical implications to be mentioned from this study. Firstly, the majority of the weaknesses in social-emotional processing were identified in women with current AN and these impairments were not found in women who had recovered from AN. Importantly we found no significant differences in the aspects of social-emotional processing tested between women who had recovered from AN compared to HC, suggesting that as well as the underpowered nature of the analyses the weaknesses identified could be related to the effects of starvation and could improve with weight restoration. Secondly there appeared to be no direct opposite pattern of processing of adult compared to infant stimuli, despite evidence to suggest that infant faces are processed differently to adult faces (e.g. Kringelback et al., 2008).

If confirmed in future studies, the weakness in identifying happiness in infants in people with AN may be improved through pharmacological interventions such as intranasal oxytocin. Intranasal oxytocin has been reported to have a range of benefits such improving emotion recognition (e.g. Guastella et al., 2010). Oxytocin has been reported to enhance particular recognition of positive facial expressions (e.g. Marsh, Henry, Pine & Blair, 2010).

In the current study women with AN were found to have fewer positive facial expressions towards happiness, this characteristic may have implications for interpersonal interactions. Diminished facial expressions might have a negative impact on engendering affiliation, liking and rapport (Hatfield, 1992; Lakin & Chartrand, 2003) by making it more difficult for the perceiver to interpret the intention in the facial expression (e.g. Healey, Pinkham, Richard, & Kohler, 2010). Facial expressions among other behaviours are important for mother-infant bonding, in particular reciprocal behaviours between mother and infant are crucial for bond formation (Atzil, Hendler, Zagoory-

Sharon, Winetraub, & Feldman, 2012; Feldman, Gordon, & Zagoory-Sharon, 2011; Atzil, Hendler, & Feldman, 2011; Reyna & Pickler, 2009). When attending to positive infant facial expressions mothers may be able to imitate positive affective behaviour (Brazelton et al., 1974; Papousek, 2007; Bell & Ainsworth, 1972). Reduced facial expressions may impact on interpersonal interactions, novel computerised interventions, which include biofeedback, could be of use in the management of these facial expressions (e.g. Claes et al., 2012).

5.19. Conclusion

The aim of this study was to examine emotional reactivity to adult and infant faces expressing basic positive and negative emotions in women with a history of an ED compared to healthy volunteers. Behavioural responses were measured through a dot-probe task and a film clip task. We found that women with AN (a) were less able to identify infant happiness; (b) had an amplified subjective response to infant sadness; (c) showed less facial mirroring of adult and infant happiness; (d) more avoidance of adults displays of emotions. The strengths and limitations of the study were discussed. Clinical interventions, such as intranasal oxytocin to address emotional recognition, or biofeedback, to improve management of facial expressions, could be used to address the weaknesses found in areas of social-emotional processing. The findings in the current study provide further support for the debate that social-emotional impairments may be as a result of the illness (e.g. due to starvation) rather than being premorbid.

Chapter 6

General Methodology for Chapter 7 and Chapter 8

6.1. Introduction to the Nutrition Eating and STress in Pregnancy (NEST-p) study

The following two studies present data from a sample of mother-infant dyads. It was important to address social-emotional processing in this sample, as the findings presented in Chapter 5 primarily showed that women with AN had anomalies in the identification of others' emotion, subjective emotional reactivity and facial expression to film clips of infants displaying basic positive and negative emotions. Exploring the independent contribution of maternal and infant behaviour to the mother-infant relationship is important and will have clinical implications for understanding processes such as bond formation (e.g. Reyna & Pickler, 2009).

6.2. Overview of the Nutrition Eating and STress in Pregnancy (NEST-p) study

The NEST-p study is a longitudinal prospective study of *in utero* mechanisms and pathways related to adverse perinatal and infant outcomes in the offspring of mothers with an active or past ED. The primary focus of the study is on the potential relationship between prenatal maternal stress, nutrition, psychopathology and obstetrics and infant postnatal outcomes.

6.3. Participants

The core NEST-p sample consisted of 137 mother-infant dyads. Group classification of mothers was ascertained through interview, of those 37 had a current ED, 39 had a past ED and 61 were HC. A full diagnosis of ED (AN, BN or EDNOS) was ascertained on the bases of symptoms described at assessment as well as in the three months prior to pregnancy. For a current ED diagnosis participants were required to meet DSM-IV criteria for ED symptoms described at assessment or in the three months prior to pregnancy. The DSM-IV ED criteria were used to ascertain a lifetime ED diagnosis based on the duration and reoccurrence of AN, BN and EDNOS. Participants whose ED remitted before their current pregnancy were recruited. Participants were considered recovered if their ED did not meet DSM-IV criteria for an ED in one or more years before their current pregnancy. The study received ethical approval (ref: 09/H0807/12) (see Appendix A14).

6.4. Inclusion and Exclusion Criteria

Cases

The inclusion criteria for the current and recovered ED groups were women who: a) had an active or past DSM-IV diagnosis of ED; b) were aged between 18-45; c) were pregnant within the first or second trimester of pregnancy. Women experiencing comorbid psychiatric illnesses were included within the current ED group, with the exception of psychotic illnesses. To minimise the effect of confounding from active psychiatric illness, women with a past ED diagnosis but active other psychiatric illness (e.g. depression, anxiety) were excluded. The exclusion criteria were any chronic medical condition (e.g. pulmonary, cardiac, autoimmune or endocrine) or an inability to communicate in English.

Healthy controls

The inclusion criteria for the HC group were women who: a) had no active or past psychiatric disorder including ED; b) were aged between 18-45; c) were pregnant within the first or second trimester of pregnancy. Women who met the criteria for a full or partial lifetime psychiatric illness were excluded. The exclusion criteria were any chronic medical condition (e.g. pulmonary, cardiac, autoimmune or endocrine) or an inability to communicate in English.

6.5. Recruitment and Screening

Participants were recruited between April 2009 and November 2012 via the following methods:

a) King's College Hospital (KCH) Obstetric Services: a random sample of women who were attending their first or second routine ultrasound scan were approached to complete a screening questionnaire, which was an adapted version of the Eating Disorder Diagnostic Scale (EDDS) that assessed ED symptoms. Women were invited to leave their contact details at the end of the questionnaire and to specify whether they would be happy for a member of the research team to contact them about the NEST-p study.
b) SLaM Perinatal Psychiatry Team: women who were referred to the perinatal liaison team at KCH for current or past ED were identified by a member of the research team (A.E.) who attended weekly perinatal psychiatry meetings or the clinical team. Women who expressed an interest in the study were contacted by a member of the research team and were given information about the study.
c) SLaM ED services: women who were in their first or second trimester were identified by clinicians involved in their treatment within ED inpatient and outpatient services. Women

who expressed an interested in the study were contacted by the researcher and were given further details about the study.

d) Advertisements: Information about the study was displayed on posters and leaflets at obstetric services at KCH and at perinatal psychiatry departments at SLaM ED services. Details about the study were also made available on websites (http://public.ukcrn.org.uk and www.iop.kcl.ac.uk). Women expressed an interest in the study by contacting the research team via the contact details provided on the advertisements.

Clinical cases were recruited through all four recruitment methods, while HC were recruited via the first and last recruitment method. Contactable and interested participants were given the full protocol description for the study. Written consent was obtained through an initial appointment. After this women were interviewed to determine lifetime psychiatric disorder and medical history, to ascertain eligibility and group classification. Presented in Figure 23 is the recruitment flow chart, which specifies the number of referrals to specialist services at SLaM and the number of women who were screened for an ED at KCH antenatal clinic.

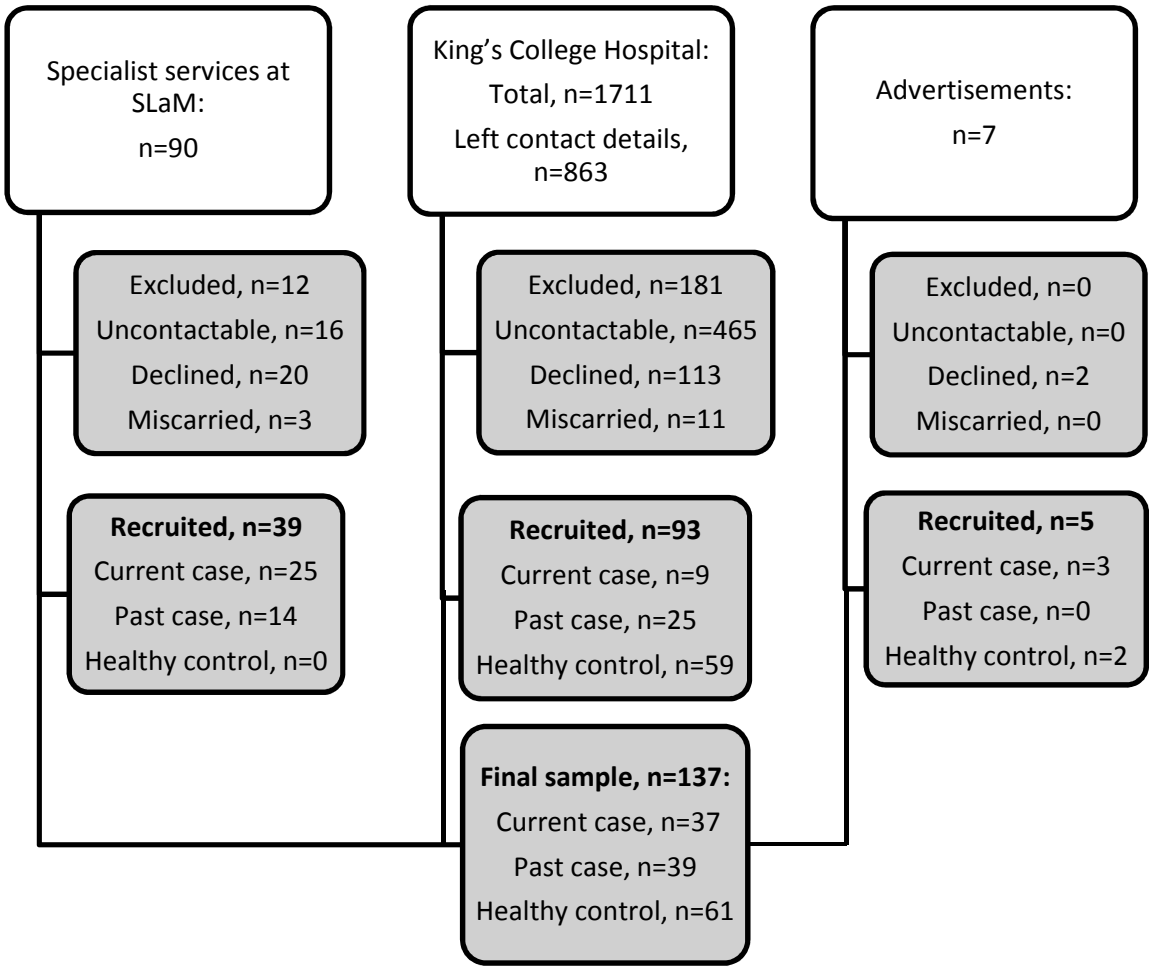

Figure 24. Schematic of recruitment flowchart for the Nutrition and Stress in Pregnancy (NEST-p) study

6.6. Materials and measures

Screening Instruments

Eating Disorders Diagnostic Scale (EDDS; Stice, Telch, & Rizvi, 2000)

The EDDS is a 22-item questionnaire used to screen those recruited through non-specialist services for DSM-IV ED symptomatology (see copy in Appendix A8). The EDDS shows good to excellent one-week test-retest reliability (kappa coefficients of 0.71 and 0.95) found for the temporal stability of BN and AN respectively (Stice et al., 2000). It has been reported that the EDDS has excellent agreement with structured psychiatric interview diagnoses (K = 0.81 (BN), K = 0.93 (AN)) (Stice et al., 2000).

For the purpose of the NEST-p study, small adjustments were made to the EDDS. Three different time points (present within 'three months', 'six months', or 'ever') were added to each question asking about specific criteria, which enabled the detection of past as well as current symptoms. Demographic questions about age and gestation were added, to allow for exclusion of those who did not meet the inclusion criteria. Women were invited to provide their contact details in a designated section at the end of the EDDS, in the event that they wanted to be contacted by a member of the research team with further details about the study.

Structured Clinical Interview for Axis I DSM-IV Disorders (SCID-I)

The SCID-I (First, 2002) is a semi-structured diagnostic interview used to determine Axis-I DSM-IV-TR disorders (Association, 2000). The presence of mood disorders, substance use disorders, anxiety disorders and ED were determined by using the research version of the SCID-I. The SCID-I interview consists of a series of open questions probing the presence or absence of DSM-IV criterion items. Most questions can be answered with a 'yes' or a 'no', although the interviewer can use prompts to encourage participants to elaborate on their answer until they have provided sufficient information for the interviewer to determine whether a criterion has been met. The SCID-I can be used to determine whether Axis-I diagnostic criteria has been met over the lifetime or whether there is a current episode, with the exception of GAD. For an ED diagnosis, the SCID-I advises that ED symptoms of a current ED should be met within the last month. For the purposes of this thesis, women who had reported ED symptoms in the three months before pregnancy – rather than within the last month alone – were included within the sample. . The SCID-I has high test-retest reliability (kappa coefficients: 0.70-1.00) (First, 2002), and between 0.61-0.77 for ED diagnosis (Lobbestael,

Leurgans, & Arntz, 2011). The SCID-I was performed by two trained researchers (A.E and E.T.) who discussed maternal diagnosis in monthly team meetings to ensure inter-rater reliability.

6.7. Maternal pregnancy variables

Socio-Demographic Questionnaire

The following socio-demographic details were obtained via self-report (see copy in Appendix A9):

-Maternal age: age at recruitment was calculated by subtracting date of recruitment from the date of birth.

-Marital status: women were asked to provide information about their marital status from a list of four options ('single', 'cohabitating', 'married' or 'other'). For the purposes of this thesis a dichotomous variable ('single' versus 'cohabitating/married') was created to synthesise the information provided about marital status.

-Ethnicity: Women were asked to report their ethnicity, based on groupings that have been used by the Department of Health since 2001, which were: 'White', 'Mixed', 'Asian', 'Asian British', 'Black' or 'Black British', 'Chinese' or 'Other Ethnic Group'. From these groupings a dichotomous variable, either 'white ethnicity' versus 'other ethnic background', was created for the purposes of this thesis.

-Education: Women were asked to report on their highest level of education achieved from four categories, which were: 'no formal qualifications', 'GCSE/NVQ', 'A-levels' and 'Higher Education'. A dichotomous variable for education was created based on 'no formal qualifications/GCSE/NVQ' versus 'A-levels/Higher Education'.

-Pregnancy height and weight: The researcher recorded height and weight of the mothers around 25-28 weeks in pregnancy. A continuous variable, pregnancy BMI (kg/m2) was calculated based on these measurements.

-Pre-pregnancy height and weight: pre-pregnancy height and weight was recorded via maternal report. A continuous variable, pre-pregnancy BMI (kg/m2) was calculated based on these measurements.

-Smoking: smoking status was ascertained from a 'yes' or 'no' answer.

-Alcohol: current alcohol consumption was determined from a 'yes' or 'no' answer.

-Current use of street drugs: current use of street drugs was determined from a 'yes' or 'no' answer.

Pregnancy Self-Report Questionnaires

Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn & Beglin, 1994)

As described in Chapter 4, the EDE-Q is a self-report version of the eating disorder examination (EDE; (Cooper & Fairburn, 1987) (see copy in Appendix A2). Like the interview, it focuses on the main

behavioural features of eating disorders that occurred within the past 28 days. Items are scored using a 7-point, forced-choice, rating scheme which measures the number of days on which particular eating disorder behaviour occurred (e.g. 'Have you felt fat?'). A global score can be derived, in addition to four subscales: restraint, eating concern, shape concern and weight concern. Scores above 4.00 are considered to be within the clinical range. The EDE-Q has been found to have good psychometric properties (Reas et al., 2006), it has been reported to have high internal consistency as well as good test-retest reliability (Luce & Crowther, 1999). The EDE-Q has shown good concurrent validity, sensitivity and specificity to identfy cases and adequate criterion validity (Mond, Hay, Rodgers, Owen, & Beumont, 2004). The EDE-Q has been tested before in samples of women with eating disorders during pregnancy (e.g. Micali, Treasure, & Simonoff, 2007).

Beck Depression Inventory (BDI) (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961)

The BDI was derived from clinical observations of depressed patients about their attitudes and symptoms (Beck et al., 1961) and has been widely used to assess the intensity and severity of depression (see copy in Appendix A10). The BDI contains 21-items which measure the intensity of symptoms on a 4-point, forced-choice, rating scheme in relation to the past few days. A total score can be derived from summing responses to the 21-items and participant scores ranging from: 1-10 are considered to be experiencing 'normal ups and downs'; 11-16 'mild mood disturbances'; 17-20 'borderline clinical depression'; 21-30 'moderate depression'; 31-40 'severe depression' and; 40 and above 'extreme depression'. It has been reported that the BDI shows good concurrent validity (Richter et al., 1998) and reliability (Beck, Steer, & Carbin, 1988). Internal consistency for the BDI has been reported to be above 0.75 (Beck et al., 1988). A review has demonstrated that the test-retest reliability of the BDI is dependent on the time difference between the measurements in addition to the composition of the sample (Richter, Werner, & Bastine, 1994). It has been reported that the BDI has good sensitivity (0.90) and specificity (0.78) during pregnancy as well as in the postnatal period been used in (sensitivity=0.81; specificity=0.80) (Ji et al., 2011).

Spielberger State-Trait Anxiety Inventory (STAI) (Spielberger & Gorsuch, 1983)

The STAI was used to measure state anxiety. The STAI is a 40-item measure that indicates the intensity of feelings of anxiety (see copy in Appendix A11). The STAI distinguishes between the propensity to experience state anxiety (e.g. a temporary condition experienced in specific situations) and trait anxiety (e.g. general tendency to perceive situations as threatening). There are 20-items per subscale which are measured on a 4-point forced choice format. Adequate test-retest reliability of the state subscale has been found (0.54) (Spielberger & Gorsuch, 1983). In an investigation of its

construct validity, the STAI has been proposed to be appropriate for use in pregnant samples (Gunning et al., 2010).

6.8. Experimental Task

Identification of Infant's Emotion

This task was based on the film task used in Chapter 5 (section 5.10.3.). Only the identification of infants' emotion was measured in the current sample due to participant's timing restrictions.

Experimental stimuli

Four one minute long film clips showed infants displaying different discrete emotions: 'happiness', 'sadness', 'frustration' and a 'neutral' displays. The film clips were acquired from YouTube and the clip depicting a frustrated infant was sourced with approval from the author (Leerkes, 2010; Leerkes, Weaver, & O'Brien, 2012). The film clips were matched for length and the display of a single person in the frame. The film clips were selected on the basis that they elicited the appropriately valenced response according to ratings made by fifteen HC using the EAS and PANAS. Following the method by Davies and colleagues (Davies et al., 2011), the order of the film clips was fixed and based on the premise that negative affect has a more lasting carry over effect. Film clips were presented in the following order: 'neutral' (baseline), 'happy', 'neutral' (repeated), 'frustrated' and 'sad' on a 15-inch computer screen.

Emotional Assessment Scale (EAS) (Carlson et al., 1989)

After each film clip was shown participants rated how strongly the infant felt, against a list of 17 emotional words (e.g. 'happy', 'angry') derived from the EAS (see copy in Appendix A7). They made their ratings on a five-point Likert scale. Scores on the positive affect scale were summed, and higher scores represented higher levels of positive affect and similarly for the negative affective scale.. The EAS has been reported to have good reliability, validity and is reliability consistent with similar emotional scales (Carlson et al., 1989).

6.9. Postnatal instruments

Brazelton Neonatal Behavioural Assessment Scale (BNBAS)

The BNBAS (Brazelton & Nugent, 1995) was used to assess newborn functioning. The instrument measures the infant's strengths and difficulties in social emotional development (see copy in Appendix A12). The BNBAS operates according to the Caregiver-Interactive System model of

newborn functioning (Als, 1978). The Caregiver-Interactive System proposes that there are four newborn developmental levels that occur with continuous environmental feedback: Physiological Stability (e.g. cardiac and respiratory function and temperature control); increased Motor Control (e.g. motor differentiation and increased homeostasis); State Differentiation (e.g. increased control of state differentiation); and Social Interactive capacity. The CNS is proposed to be the driving force of these adjustments, with internal and external feedback systems (Brazelton, 1990). The model is stepwise, meaning that a developmental level is the prerequisite of the following level. Each developmental level is different to the previous level, rather than being an improvement or a refinement. It is expected that a full-term healthy newborn will be working towards the third developmental level, State Differentiation.

The BNBAS is based on a number of assumptions about newborn functioning (Als, 1978; Als, Tronick, Lester, & Brazelton, 1977): (a) a newborn is a social being; (b) newborns attempt to enhance their own organisation by eliciting from the caregiver the organisation which they have not yet developed. Appropriate caregiving behaviours are enhanced through a process in which the newborn elicits organisation and feedback; (c) newborns can elicit stimulation from their environment which is necessary for their motor, emotional, social and cognitive development; (d) newborns are capable of controlling motor and autonomic responses, for the purpose of attending to important external stimuli; (e) newborns are capable of defending themselves from negative stimuli.

The BNBAS consists of 28 behavioural 20 reflex items. The most commonly used method of data reduction for the BNBAS is the Lester cluster scoring method (Lester et al., 1982), which reduces the data into six behavioural and one reflex cluster: (a) Orientation, reflects attention to visual and auditory stimuli during alert states; (b) Motor organisation, includes the quality of muscle tone and movement; (c) Regulation of State, assesses the quality of the newborn's responses when aroused and ability to control arousal; (d) Autonomic organisation, reflects physiologic responses to stress; (e) Range of state, which assessed level of arousal; (f) Reflexes, which document the number of abnormally elicited reflexes; (g) Habituation, assesses the newborn's reactivity to stimulation from a rattle, bell, light, and mild pin prick, as well as response decrement while in a light sleep state. A higher score on all the behavioural items indicates better newborn performance, while higher scores on indicate deviant reflexes on the reflex cluster.

Overall the BNBAS shows excellent construct and criterion validity, adequate in content validity and responsiveness and poor reliability (Noble & Boyd, 2012). Interrater reliability is usually high, between 65%-100% (Maier et al., 1983). Low test-retest reliability has been argued to be a result of

temporal factors, owing to the rapid changes in the newborn period (Horowitz & Linn, 1984). The BNBAS was administered in optimal testing conditions in-between feeds in a quiet semi-darkened room (Brazelton & Nugent, 1995), to elicit best performance from the newborn. The BNBAS was performed by two trained and certified researchers (F.C. and S.P.) who were trained to standard levels of reliability (i.e. 90% reliability). The researchers were blind to maternal diagnosis.

6.10. Postnatal Bonding Questionnaire

Mother-to-Infant Bonding (MIB) (Taylor, Atkins, Kumar, Adams, & Glover, 2005)

The Mother-to-Infant Bonding (MIB) scale is self-report questionnaire designed to provide an indication of early mother-infant bonding (see copy in Appendix A13). The bonding scale consists of 8-items which measure maternal feelings toward her newborn (e.g. 'joyful', 'protective'). Items are assessed on a 4-point, forced-choice, rating scheme in relation to the first few weeks after her child was born. A total score is derived for bonding and higher scores indicate worse mother-to-infant bonding. The temporal stability of the bonding questionnaire appears to be strong, in the validation study (Taylor et al., 2005) a significant correlation was reported between administration at 3 days and 12 weeks postnatal. The reliability of the bonding questionnaire has been reported to be good (alpha=0.71; Taylor et al., 2005).

Chapter 7

Identification of infants' emotion in women with eating disorders during late pregnancy: A preliminary study

7.1. Infant faces

As described in Chapter 5, infant faces are highly salient stimuli (e.g. Kringelbach et al., 2008) and elicit strong caregiver responses (Bowlby, 1980). Lorenz (Lorenz, 1943) proposed that *Kindchenschema* (or baby schema), referring to the infantile qualities of facial features, such as large eyes, facilitate caregiving responses for the purpose of increasing the infant's chances of survival. In parent-infant exchanges*, intuitive parenting* behaviours have been documented. Parents consistently modify their speech, facial expressions and other movements towards infants (Papousek, 1977). Maternal sensitivity is important for positive mother-infant relationships and requires the mother to engage with and respond to her infant's communication (Ainsworth, 1978).

7.2. Perinatal maternal sensitivity

Functional imaging studies show that neurobiological changes occurring as a result of reproduction may encourage maternal sensitivity. The postpartum period appears to be accompanied by significant maternal brain changes (e.g. increases in gray matter volume) associated with maternal sensitivity to infant cues (Kim et al., 2010). Additional changes in neuroendocrine systems, such as oxytocinergic systems and dopamine-reward processing, might facilitate the regulation of maternal behaviours, for example increased responsiveness to photographs of infant distress (Strathearn et al., 2009). Maternal sensitivity to infant cues appears to be impaired in women with postnatal depression (Campbell, Matestic, von Stauffenberg, Mohan, & Kirchner, 2007; Field, 2010; Murray, Fiori-Cowley, Hooper, & Cooper, 1996). The ability to recognise happy infant displays is also impaired (Arteche et al., 2011). In conclusion changes in neurobiological systems in the postpartum period may heighten maternal responsiveness.

It has been argued from an evolutionary perspective that maternal sensitivity may increase during pregnancy, rather than merely in the postnatal period (Pearson et al., 2012). Maternal attention to distressed infant faces during late pregnancy was associated with the quality of later mother-infant interactions; low prenatal attention to distressed infant displays was related to poorer mother-infant interactions (Pearson et al., 2011). Symptoms of depression during pregnancy appear to alter maternal responsiveness to infant cues. Women without depression took longer to disengage

attention from distressed infant facial displays compared to women with depression (Pearson, Cooper, Penton-Voak, Lightman, & Evans, 2010). When confronted with a distressed infant display, pregnant women with depression reported 'wanting to turn away' more and 'wanting to comfort' less than normal controls (Macrae, 2012). Women experiencing anhedonic depressive symptoms during pregnancy had significantly larger systolic blood pressure responses to distressed infant displays compared to non-depressed pregnant women (Pearson, Lightman, & Evans, 2012). High maternal depression during pregnancy only and not at 8 months postpartum was associated with a 30% increased risk of low maternal responsiveness with infant at 12 months compared to a group of women with consistently low depression (Pearson et al., 2012). Maternal sensitivity may therefore be enhanced in the prenatal period. Like in the postnatal period, women with prenatal depression symptoms show reduced maternal responsiveness to infant cues of distress, which might be associated with increased sympathetic sensitivity.

7.3. Reception of Facial Communication in Eating Disorders

People with AN have a poor recognition of postive and negative adult facial emotional expressions (Oldershaw et al., 2011). Little is understood about caregiving relationships in ED. Women with ED underestimated infant happiness in film clips when compared to healthy women, as described earlier in Chapter 5. What remains unclear is whether ED pregnancy status would influence perception of emotional intensity of infant facial displays.

7.4. Study aim

The aim of this study is to investigate the perception of the emotional intensity of infant displays during late pregnancy in women with ED compared to HC. An additional aim was to examine whether specific maternal psychopathology, i.e. ED symptoms, and maternal BMI during pregnancy could predict perception of infant emotion.

7.5. Hypotheses

1. We expected that cases (both currently ill and those who had recovered) would be less likely to be able to accurately identify the infant's emotions, rating them as less intense, compared to HC during pregnancy.

2. We expected that higher levels of maternal psychopathology and lower BMI would be associated with reduced ratings of the emotional intensity of infant facial displays.

7.6. Methods and materials

Refer to the previous chapter (Chapter 6) for the full descriptions of the sample and measures used in the current study.

7.6.1. Participants

Following initial screening assessments for the NEST-p study, a subsample of 28 women (20%) who completed both maternal psychopathology questionnaires during pregnancy and participated in the experimental task were included. (The experimental task showing infants in film clips was added to the NEST-p protocol at a late stage, therefore data were not available for the wider sample). The subset included 8 current and past ED cases and 20 HC women. Of those recruited as clinical cases, 4 had a current ED and 4 had a past ED. The number of participants does not allow for statistical comparison between diagnostic classifications. Of those women with a current ED, three had BN-P and one had AN-BP. Within the sample of those with a past ED, two had AN-R and one had BN-P. There was insufficient data for the fourth, although she had a lifetime ED type of EDNOS-ANR.

7.6.2. Measures and procedure

Women were recruited at an average of 20.60 weeks gestation (range of 12-37.14 weeks) and filled out questionnaires regarding demographic information. In mid pregnancy, 25.73 weeks gestation (range of 15.29 – 28.86 weeks), participants filled out a questionnaires which they received through the post about disordered eating behaviours, symptoms of depression and state anxiety. At 28 weeks gestation participants attended an appointment with the researcher to complete the experimental task.

7.6.3. Statistical analyses

Statistical analyses were performed using SPSS version 21. Data from the current and past clinical cases were combined into a single ED group to increase power. Maternal demographic categorical variables, which were presented in numbers and percentages, were compared with the χ^2 test. Quantitative variables were non-normally distributed according to the Kolmogorov-Smirnov tests and the logarithm transformation failed. Mann-Whitney U test was used to examine comparisons between quantitative self-report and experimental variables. Linear and multiple regressions were performed to examine whether maternal psychopathology and pregnancy BMI was related to

ratings of the emotional intensity of infant displays. A power calculation based on the findings of Stein et al. (2010) calculated that a sample size of 119 per group would be necessary to give an effect size of .36 with power at .80 (calculated using the G*Power program; Erdfelder, Faul & Buchner, 1996).The p-value for two-tailed significance was set to .05. The ESs can be interpreted using Cohen's convention of small (0.2), medium (0.5) and large (0.8).

7.7. Results

7.7.1. Sample Demographics

Socio-demographic characteristics of women in the ED group and HC are presented in Table 9. Data concerning maternal age at recruitment, marital status, education and ethnicity were available for 86% of the participants. The overall sample was largely composed of women of white ethnicity, who reported to be married/cohabiting and highly educated to university level. No significant differences were found between groups on age, pre-pregnancy or pregnancy BMI or alcohol use. None of the participants reported to taking street drugs or smoking during pregnancy.

Table 9. Maternal demographic variables in women with active and past eating disorders versus healthy controls. (ED: history of an eating disorder; HC: Healthy Control)

	ED	HC	Test Statistic
Maternal Age: med (IQR)	31, (29.25) n=8	35, (31-37) n=20	U= 54.50, p= .199
Pre-Pregnancy BMI: med (IQR)	21, (19-24) n=6	21, (20-22) n=19	U= 53.00, p= .828
Pregnancy BMI: med (IQR)	24, (22-27) n=5	24, (22-25) n=16	U= 33.00, p= .603
White ethnicity: n (%)	100%, n=8	89%, n=18	X^2 (1)=.727, p= .554
Married/ Cohabiting: n (%)	100%, n=8	89%, n=18	X^2 (1)=.963, p= .471
Education: Alevels/Higher: n (%)	88%, n=5	89%, n=8	X^2 (1)=.010, p= .686
Current smoking: Yes/No: n (%)	0%, n=7	0%, n=20	N/A
Current alcohol: Yes/No: n (%)	43%, n=7	10%, n=20	X^2 (1)=3.710, p=.091
Current street drugs: Yes/No: n (%)	0%, n=7	0%, n=20	N/A

7.7.2. Maternal State Psychopathology

Descriptive statistics relating to maternal state psychopathology are presented in Table 10. As expected the mean EDEQ global and subscale scores varied significantly by group. Women assigned to the ED group had significantly higher EDEQ scores compared to HC. Depression symptoms were marginally significant between groups; women in the ED group had higher symptoms of depression than HC. State anxiety varied significantly between groups, women with a history of an ED had significantly higher mean state anxiety than HC.

Table 10, Symptoms of disordered eating, depression and anxiety in women with active and past eating disorders versus healthy controls. (ED: history of an eating disorder; HC: Healthy Control)

	ED=8		HC=20		Test Statistic	ES
EDEQ: med (IQR)	0.96	(0.30-1.78)	0.08	(0.00, 0.30)	U= 22.50, p= .002	d=1.17
EDEQ-R: med (IQR)	0.50	(0.10-1.95)	0.00	(0.00, 0.40)	U= 41.00, p= .049	d=1.00
EDEQ-SC: med (IQR)	1.13	(0.50-2.00)	0.25	(0.00, 0.59)	U= 27.00, p= .006	d=1.24
EDEQ-WC: med (IQR)	0.70	(0.13-2.05)	0.00	(0.00, 0.30)	U= 35.50, p= .021	d=0.93
EDEQ-EC: med (IQR)	0.70	(0.70-2.75)	0.00	(0.00-0.20)	U= 18.50, p= .001	d=1.14
BDI: med (IQR)	8.50	(3.75-9.75)	4.50	(2.25-6.00)	U= 42.50, p= .055	d=0.71
STAI-S: med (IQR)	34.50	(28-46.25)	25.00	(23.00-35.50)	U= 36.00, p= .025	d=0.94

7.7.3. Maternal ratings of intensity of infant displays

Maternal ratings of the emotional intensity of infant displays are presented in Table 11. No significant differences were found between groups in maternal ratings of the intensity of infant displays of emotion in short film clips.

Table 11. Maternal ratings of the emotional intensity of infant displays by women with eating disorders versus healthy controls. (ED: history of an eating disorder; HC: Healthy Control)

Infant Emotion	ED N=8		HC N=20		Test Statistic	ES
Happy: med (IQR)	16	(13.50-16.75)	14	(12-16)	U= 55.50, p =.218	d=0.30
Frustrated: med (IQR)	21	(14.00-28.75)	17	(13.50-22.50)	U= 65.00, p =.469	d=0.35
Sad: med (IQR)	15.50	(7.25-23.75)	11.50	(5.50-18.75)	U= 62.00, p =.381	d=0.35
Total	52.50	(43.25-63)	48	(31.75-51.75)	U= 58.50, p=.281	d=0.40

7.7.4. The predictors of ratings of the intensity of infant emotional displays

Multiple linear regressions were carried out to test whether maternal psychopathology (EDEQ, BDI and STAI-S) during pregnancy significantly predicted participant's ratings of the intensity of infant emotion, unadjusted for variables such as gender (Table 12). The regressions were performed to confirm the lack of significance found in the maternal ratings between groups.

None of the models were significant [Happy infant: F(3, 24) .253, p=.858 predicted 0.3% of the variance; Frustrated infant: F(3, 24) .011, p=.998 predicted 0.1% of the variance; Sad infant: F(3, 24) 1.530, p=.232 predicted 0.6% of the variance; All infant emotions: F(1, 26) .001, p=.970 predicted 0% of the variance]. ED symptoms significantly predicted ratings of infant sadness to a marginal extent. None of the EDEQ subscales were found to be significant predictors of ratings of infant emotional displays.

Table 12. Examination of the impact of maternal psychopathology on maternal ratings of the emotional intensity of infant displays: linear regression analysis.

	Unstandardised coefficients		Standardised coefficients	T	Significance
	B	Standard Error	B		
Happy infant					
(Constant)	15.483	3.013		5.139	.000
EDEQ-T	.505	.917	.119	.551	.587
BDI	-.141	.267	-.113	-.527	.603
STAI-S	-.038	.105	-.083	-.364	.719
Frustrated infant					
(Constant)	18.500	6.750		2.741	.011
EDEQ-T	.356	2.055	.038	.173	.864
BDI	-.026	.599	-.009	-.042	.967
STAI-S	-.013	.234	-.012	-.053	.958
Sad infant					
(Constant)	13.905	5.537		2.511	.019
EDEQ-T	3.443	1.685	.409	2.043	.052
BDI	-.230	.491	-.094	-.469	.643
STAI-S	-.041	.192	-.045	-.214	.833
Total emotions					
(Constant)	44.861	12.802		3.504	.002
Maternal psychopathology	.038	1.003	.007	.037	.970

Linear regressions were run to test whether maternal BMI during pregnancy predicted ratings of the intensity of infant emotions (Table 13). The model for maternal BMI predicting response to infant sadness was significant [F (1,19) 5.984, p=.024 and explained 24% of the variance]. Neither model which tested whether maternal BMI predicted infant happiness or frustration was significant [Happy infant: F (1,19) 1.952, p=.179 and predicted 9% of the variance; Frustrated infant: F (1,19) 2.314, p=.145 and predicted 11% of the variance].

Table 13. Examination of the impact of maternal BMI during pregnancy on maternal ratings of the emotional intensity of infant displays: linear regression analysis.

	Unstandardised coefficients		Standardised coefficients	T	Significance
	B	Standard Error	B		
Happy infant					
(Constant)	5.170	6.532		.791	.438
Maternal BMI	.381	.273	.305	1.397	.179
Frustrated infant					
(Constant)	-4.570	15.784		-.290	.775
Maternal BMI	1.002	.659	.329	1.521	.145
Sad infant					
(Constant)	-19.162	13.820		-1.387	.182
Maternal BMI	1.411	.577	.489	2.446	.024

7.8. Discussion

7.8.1. Study aim

Maternal sensitivity has important implications for positive mother-infant relationships (Ainsworth, 1979). The aim of this preliminary study was to examine maternal identification of infant emotion in women with ED compared to HC during late pregnancy.

7.8.2. Maternal sensitivity

In the first hypothesis we stated that we would expect that cases (both currently ill and those who had recovered from an ED) would be less likely to be able to accurately identify the infant's emotions, rating them as less intense, compared to HC during pregnancy. This hypothesis was not supported, as women with a current or past ED had similar ratings of infant emotion as HC. The ratings made by women with a current or past ED were higher in emotional intensity compared to HC, but these differences were not significant. Given the small sample size, it is difficult to confirm whether this is a false negative or a true finding. Previous literature shows that people with AN have anomalies in sensory sensitivity. They are more sensitive to sensory stimuli, report more behavioural avoidance and less sensation seeking (Zucker et al., 2013). It is possible that these anomalies identified in sensory sensitivity could be related to emotional reactivity. According to Aron and Aron

(Aron & Aron, 1997) high emotional reactivity drives traits of sensory-processing sensitivity (SPS) . Strong emotional reactions faciliate a deeper and more complex processing strategy, involving a greater sensitivity to subtle stimuli and an increase in time taken to process and respond, appearing as more risk aversive (Aron, Aron, & Jagiellowicz, 2012). In the current study we found no differences in ratings between women with a current or past ED and healthy women, indicating that perhaps the infant cues elicited similar levels of emotional reactivity in both groups.

In the second hypothesis we proposed that higher levels of maternal psychopathology and lower BMI would be associated with reduced ratings of the emotional intensity of infant facial displays. As expected, maternal psychopathology was higher in women with ED. We found that there was a trend to suggest that ED symptoms alone predicted ratings of infant sadness; higher ED symptoms predicted higher negative ratings of infant sadness. Additionally maternal BMI during pregnancy significantly predicted ratings of infant sadness; higher BMI predicted higher in negative ratings of infant sadness. Earlier literature shows that both ED symptoms and low weight predict a greater difficulty in discriminating sad adult faces when presented for a short duration (500ms) in people with AN (Castro et al., 2010). Important aspects of ED psychopathology appear to be linked with strong emotional response, especially for sadness cues. It is possible that response to infant sadness is related to empathy, this is consistent with other studies stating that vicarious distress to others suffering (Beadle, Paradiso, Salerno & McCormick, 2013) and normal levels of affective empathy in AN (Calderoni et al., 2013).

7.8.3. Strengths and limitations

The primary strength of this study is that it is the first to examine maternal sensitivity during the prenatal period in women with ED. The prospective design of the study was particularly advantageous in that it allowed for associations to be examined. Additionally ED classification and other psychiatric diagnoses were determined through a diagnostic interview. Presenting infant displays through film clips have been suggested to be more ecologically valid than through photographic stimuli (Pearson et al., 2012).

This study has a number of shortcomings which need to be highlighted. The main limitation was that the study was considerably underpowered; the sample size was small, especially for the clinical cases. Cases in the current and recovered group were combined which prevented the formal testing of state of trait differences in the ED group. There were missing data from those participants who

did not return questionnaire measures during pregnancy, which further reduced the sample and might have introduced bias to the results. Secondly it is unclear at which stage during pregnancy maternal sensitivity should be investigated as a precursor of maternal responsivity in the postnatal period. Thirdly including a psychiatric control group of women with depression might have helped to improve the understanding of the specificity of the results on this task. As symptoms of depression appear to be more common during pregnancy than in the postnatal period (Evans, Heron, Francomb, Oke, & Golding, 2001). The majority of studies have reported that ED attitudes and behaviours are reduced during pregnancy (Blais et al., 2000; Bonne, Rubinoff, & Berry, 1996; Crow, Agras, Crosby, Halmi, & Mitchell, 2008; Lacey & Smith, 1987; Micali et al., 2007) and women with ED tend to experience an increase in depression and anxiety during (Micali et al., 2011). Fourthly data were not available concerning maternal anti-depressant medication, which may have had implications for the results. Anti-depressants, such as Reboxetine and Citalopram, have been found to increase the ability to process happy infant faces (Stein et al., 2012), and in the present study clinical cases could have had an increased advantage for perceiving happy infant displays. Lastly there were several issues with the experimental task, as mentioned earlier in Chapter 5. For example, the film clips were only matched on two features (e.g. length and discrete emotion) which means that other factors were not accounted for (e.g. infant age). The time taken to complete the ratings was not measured, which prevented the investigation of temporal factors in the identification of infant emotion.

7.8.4. Clinical implications

Maternal sensitivity to infant distress during pregnancy could be a precursor of postnatal parenting behaviour. Little is understood about caregiving relationships in ED, especially that of maternal behaviours during interactions. Stein and colleagues (Stein, Woolley, Cooper, & Fairburn, 1994) observed that mothers with ED expressed more negative emotion towards their infants during meal times and the emotional tone of offspring of mothers with ED was generally more negative. Mothers with ED used more verbal control with their infants, especially during play time (Stein, 2001). These aspects of maternal behaviour may influence offspring response, for example a recent study showed that children of mothers with AN have high social interpretation skills (Kothari, Solmi, Treasure, & Micali, 2013).

Caregiving relationships in depression are better understood, with maternal responsiveness documented in naturalistic settings. During observed mother-infant interactions, mothers who were depressed were less engaged, had less eye contact and exhibited more negative behaviour to signals of distress from their infant (Field, Diego, & Hernandez-Reif, 2006; Murray et al., 1996). Maternal

sensitivity to infant distress is particularly altered in mothers with depression. In observations of mother-child interactions, mothers with depression were less responsive to their child's distress compared to non-depressed mothers; no significant differences were observed in maternal response to child's positive behaviour (Shaw, Levitt, Wong, & Kaczorowski, 2006). Maternal depression predicted sensitivity to infant distress vocalisation, women with depression experienced more difficulty discriminating an infant's cry sound (Donovan, Leavitt, & Walsh, 1998). Maternal sensitivity to infant distress cues is particularly impaired in women with depression. Depression was not found to predict response to infant emotions in the current study, which might indicate differential maternal response in ED and in depression.

7.8.5. Conclusion

The aim of this study was to investigate maternal identification of infant emotion in women with ED compared to HC during late pregnancy. This study shows that women with ED and HC had similar response to the identification of infant emotion during late pregnancy. Maternal psychopathology was higher in women with ED, disordered eating symptoms and BMI predicted ratings of infant sadness.

Chapter 8

Caregiver-interactive system in women with eating disorders: newborn behaviour and mother infant-bonding.

8.1. Increased familial risk

As highlighted in Chapter 1, the offspring of parents with a psychological disturbance are reported to be at an increased risk of a disturbance themselves (Garmezy, 1996; Rutter & Quinton, 1984; Rutter, 1989). Family and twin studies show that ED are strongly familial (Strober, Freeman, Lampert, Diamond, & Kaye, 2000) which might be explained by genetic factors (Bulik et al., 2000). Children of mothers with ED appear to be at an increased risk of adverse developmental outcomes (e.g. Park et al., 2003). The literature consistently shows altered feeding, eating and growth trajectories in the offspring of mothers with ED (Micali et al., 2007; Micali et al., 2009, 2011; Patel et al., 2002; Stein & Fairburn, 1989; Stein et al., 2006; Torgersen et al., 2010). The offspring of mothers with ED are an at risk group, which might have implications for developmental outcomes.

8.2. ED status linked to offspring risk

The underlying mechanisms by which the offspring of mothers with ED become at risk are not certain. A theoretical model proposes that maternal ED during pregnancy increases the risk for the foetus, via two pathways: nutritional factors and comorbid psychopathology (Micali et al., 2009). ED are highly comorbid with anxiety (Kaye et al., 2004; Keel et al., 2005) and depression (Wade et al., 2000) and women with lifetime ED reported more severe perinatal depression compared to women with no ED (Meltzer-Brody et al., 2011). Women with ED are much more likely to experience perinatal complications (Bulik et al., 2009; Micali et al., 2009), preterm delivery (Morgan, Lacey, & Chung, 2006; Sollid, Wisborg, Hjort, & Secher, 2004) and have offspring with a lower birth weight (Abrams & Laros Jr, 1986). ED status has been linked with adverse offspring development around the perinatal period.

8.3. Foetal programming

Foetal programming refers to the process whereby the in utero environment during pregnancy is linked to foetal development as well as development across the lifespan (Godfrey & Barker, 2001). The 'Barker hypothesis' suggests that adverse influences in early development, such as intrauterine under-nutrition, can lead to permanent changes in body structure and metabolism, which result in

an increased risk of metabolic disease later in life . There is now a growing body of literature which shows strong evidence to support the Barker Hypothesis (Barker, 1998; Barker, Bull, Osmond, & Simmonds, 1990).

It is suggested that the infant is most ready to learn to understand emotions and to develop an attachment within the first three months postpartum (Fonagy, 1998). The way in which the newborn is handled and interacted with influences the structure of the infant's brain (Als et al., 2004). Maternal symptoms of depression and anxiety occur frequently during pregnancy. Maternal mood has been linked to newborn development measured by the BNBAS (Als, 1978; Anderson, 1986; Brazelton & Nugent, 1995). In 1973 the BNBAS (Brazelton & Nugent, 1995) was introduced as a clinical instrument to understand the newborn's contribution to the parent-infant relationship (see Chapter 6 for full measure description). The BNBAS operates according to the Caregiver-Interactive System model of newborn functioning (Als, 1978). The instrument measures the infant's strengths and difficulties in social, behavioural and neurological development. Items on the BNBAS are commonly reduced into six behavioural clusters (Habituation; Orientation; Motor organisation; Regulation of State; Autonomic organisation; Range of state) and an abnormal reflex score.

8.4. Maternal prenatal depression symptoms

It has been consistently shown that maternal depression during pregnancy influences newborn behaviour. Newborns of mothers with depression symptoms have poorer Orientation (Abrams et al., 1995; Diego et al., 2005; Hernandez-Reif et al., 2006; Lundy et al., 1999), State Regulation (Diego et al., 2005; Goodman et al., 2011; Pacheco & Figueiredo, 2012), Range of State (Pacheco & Figueiredo, 2012), Motor Organisation (Diego et al., 2005) and Autonomic Regulation (Goodman et al., 2011) compared to neonates of non-depressed mothers. Neonates of mothers with depression are less alert (Hernandez-Reif et al., 2006), spend more time in deep sleep states (Jones, 2012) and experience a greater difficulty protecting sleep states (Diego et al., 2005; Pacheco & Figueiredo, 2012) and have more abnormal reflexes (Lundy et al., 1999). Newborns of mothers with dysthymia are have especially poor Orientation compared to mothers with major depression (Field et al., 2008). Chronicity of maternal depression has been associated with Autonomic Regulation, as length of maternal depression increased Autonomic Organisation worsened (Goodman et al., 2011). In this sample, 19.5% of mothers with depression were taking anti-depressants, while only 9.1% of control mothers were using antidepressants. Poor newborn behaviour is associated with maternal prenatal depression symptoms.

8.5. Maternal prenatal anxiety and stress symptoms

Compared to maternal depression, there is relatively little understood about the relationship between maternal anxiety and stress and newborn behaviour. Maternal stress and anxiety appears to be linked with newborn responses (Oyemade et al., 1994). Newborns of mothers with anxiety (Brouwers et al., 2001) and chronic stress (Rieger et al., 2004) during pregnancy show poorer Orientation, those newborns of mothers with chronic stress also showed poorer State Regulation (Rieger et al., 2004). Maternal prenatal anxiety and stress appear to be linked with poorer newborn behaviour.

8.6. Maternal prenatal bonding with newborn

Maternal thoughts and feelings about her baby develop during pregnancy and increase when the baby is born (Kumar, 1997). They motivate affection and protective feelings, which can facilitate the beginning of mother-infant relationship (Bretherton & Ainsworth, 1974). It has been proposed that maternal ED interferes with mother-infant bonding during the postpartum period (Astrachan-Fletcher et al., 2008). Women with a history of an ED report more problems with maternal adjustment 3 months after delivery than women with no ED history (Koubaa et al., 2008). Low maternal-foetal attachment and bulimic psychopathology were reported to be independent risk factors for low maternal sensitivity and warmth toward the infant during the postnatal period (Lai & Tang, 2008). Women with high body shape and weight concerns were reported to be less likely to breast-feed their infants; this was linked with low foetal attachment status during pregnancy (Foster et al., 1996). Maternal disordered eating has been associated with altered patterns of foetal attachment, which might have implications for subsequent bonding within the newborn period.

8.7. Study aims

The aim of this study is to investigate whether maternal prenatal ED is linked with both poorer newborn behaviour and with less than optimal mother-newborn bonding. A further aim was to investigate the relationship between maternal psychopathology and newborn behaviour.

8.8. Hypotheses

We expected that newborns of mothers with a current ED would have suboptimal scores on the BNBAS compared to newborns of mothers with no ED and to newborns of mothers with a past ED. We expected that mothers with a current ED would experience more problems with mother-infant

bonding compared to those who have recovered from an ED and HC. We expected that greater maternal psychopathology would be associated with less optimal infant development and bonding.

8.9. Methods and materials

8.9.1. Participants

As outlined in Chapter 6, the core NEST-p sample contains 137 women and infant dyads. Women were allocated to one of three groups following an interview screening, 37 had a current ED, 39 had a past ED and 61 were HC.

A subset of 16 cases with a current ED, 20 cases with a past ED and 28 HC women and their newborns who took part in the newborn assessment were included in the study (47%). Of those current cases, 2 cases had AN-R, 5 had AN-BP, 5 had BN-P. There were insufficient data available for three cases, although one had a lifetime ED type of EDNOS-ANR. Within the recovered cases, 4 had AN-R, 4 had AN-BP, 5 had BN-P, one had BED and 4 had EDNOS-ANR. There were insufficient data available for two cases.

8.9.2. Procedure

Following initial screening assessments for the NEST-p, 36 ED cases (active n=16; past n=20) and 28 HC women and their newborns participated in this study in a between groups design. Women were recruited at an average of 11.60 weeks gestation (range of 7.83 – 22.08 weeks) and filled out a questionnaire regarding demographic information. In the mid pregnancy, 28.91 weeks gestation (range of 14.86 – 39.86 weeks), participants filled out questionnaires which they received through the post about disordered eating behaviours, symptoms of depression and state anxiety. The BNBAS was performed on the offspring of the mothers included in the study during the early neonatal period at mean age 8.73 days postnatal (range of 5 days – 30 days), as it was recommended that the BNBAS be performed in the days following birth to allow for the stresses of delivery and medication to reduce (Brazelton & Nugent, 1995). Women were contacted around their child's first birthday and filled in a retrospective questionnaire about mother-to-infant bonding in relation to the first few weeks of the postnatal period.

8.9.3. Statistical analyses

The statistical analyses were performed using SPSS version 21. One current ED participant was excluded from the analysis as the BNBAS was conducted at 72 days. Later administration of the BNBAS can be expected to be associated with an increase in performance (e.g. (Canals et al., 2006). It has been advised that the BNBAS should not be performed after the newborn reaches 30 days due to ceiling effects (Brazelton, 1978). The Habituation cluster was not presented in the thesis as too few newborns were awake at the beginning of the examination (current ED=3; recovered ED=4 and HC=7), this is a common occurrence in BNBAS examinations (Sutter-Dallay, Murray, Glatigny-Dallay, & Verdoux, 2003). Maternal demographic categorical variables, which were presented in numbers and percentages, were compared with the χ^2 test between groups. One-way ANOVA was used to test between group differences on quantitative data which were normally distributed (maternal age; BNBAS outcomes: Orientation, Motor, Autonomic, Regulation) according to the Kolmogoov-Smirnov test. Quantitiave data which were non-normally distributed and was not corrected by logarithm transformation, therefore it was analysed using Kruskall-Wallis and Mann-Whitney U tests. Spearman's rho correlations were performed to examine associations between MIB and newborn behaviour. Linear and multiple regressions were performed to examine whether maternal psychopathology and was related to newborn behaviour. The p-value for two-tailed significance was set to .05. The ES can be interpreted using Cohen's convention of small (0.2), medium (0.5) and large (0.8).

8.10. Results

8.10.1. Maternal Demographics

Socio-demographic characteristics of women in the ED group and HC are presented in Table 14. Data concerning maternal demographic variables were available for 76% of the participants. The overall sample was largely composed on women of white ethnicity, who reported to be married/cohabiting and highly educated to university level. Mothers with a current ED were significantly younger than HC mothers. No significant differences were found between pre-pregnancy BMI, pregnancy BMI, current smoking or alcohol intake. None of the participants reported taking street drugs during pregnancy.

Table 14. Maternal demographic variables in women with active and past eating disorders versus healthy controls. (ED current: active eating disorder; ED Past: past eating disorder; HC: Healthy Control)

	ED current=15		ED past=20		HC=28		Test Statistic
Maternal Age: mean (sd)	28.93[a]	(6.18)	30.25[d]	(4.80)	33.50[b]	(5.37)	F(2, 53) =3.753, p=.030*
Pre-pregnancy BMI: med (IQR)	20.38[h]	(18.46-22.22)	21.88[h]	(20.53-28.52)	20.89[h]	(20.09-22.25)	H(2) =4.439, p= .109
Pregnancy BMI: med (IQR)	23.56[e]	(20.19-26.05)	24.12[l]	(20.54-28.32)	23.46[k]	(20.86-24.62)	H(2) =.396, p= .821
White ethnicity: n (%)	89%[g]		93%[f]		88%[e]		X^2 (2)=.266, p=.876
Married/ Cohabiting: n (%)	67%[c]		72%[b]		80%[c]		X^2 (2)=.836, p=.658
Education: Alevels/Higher: n (%)	92%[c]		67%[h]		92%[d]		X^2 (2)=4.516, p=.105
Current smoking: Yes/No: n (%)	60%[j]		18%[i]		0%[k]		X^2 (2)=4.718, p=.095
Current alcohol: Yes/No: n (%)	13%[g]		38%[g]		23%[f]		X^2 (2)=1.946, p=.378
Current street drugs: Yes/No: n (%)	0%[g]		0%[h]		0%[g]		N/A

Note. Missing data: [a]n=1; [b]n=2; [c]n=3; [d]n=4; [e]n=5; [f]n=6; [g]n=7; [h]n=8; [i]n=9; [j]n=10; [k]n=11; [l]n=12. *Post-hoc: Current ED < HC, *p*=.042.

8.10.2. Maternal Psychopathology

Descriptive statistics relating to maternal psychopathology are presented in Table 15. As expected the median EDEQ global and subscale scores varied significantly between groups. Women with ED had significantly higher EDEQ scores compared to HC. Depression symptoms were significantly between groups; women with an active and past ED had higher symptoms of depression than HC. State anxiety varied significantly between groups, women with an active or past ED had significantly higher median state anxiety than HC.

Table 15. Symptoms of disordered eating, depression and anxiety in women with active and past eating disorders versus healthy controls. (ED current: active eating disorder; ED Past: past eating disorder; HC: Healthy Control)

	ED current=11		ED past=19		HC=25		Test Statistic	Post-hoc	ES
EDEQ: med (IQR)	1.96	(1.10-2.71)	0.66	(0.36-1.20)	0.08	(0.00-0.28)	H(2)= 32.99, p<.001	C>HC p<.001 P>HC p<.001 C>P p=.002	d=2.97 d=1.24 d=1.20
EDEQ-R: med (IQR)	0.80	(0.00-2.20)	0.40	(0.00-0.60)	0.00	(0.00-0.30)	H(2)= 10.328, p=.006	C>HC p=.003 P>HC p=.039 C=P p=.145	d=1.54 d=0.67 d=0.62
EDEQ-SC: med (IQR)	2.50	(1.25-3.88)	1.25	(0.50-1.75)	0.25	(0.00-0.50)	H(2)= 29.158, p<.001	C>HC p<.001 P>HC p<.001 C>P p=.009	d=1.94 d=1.26 d=1.26
EDEQ-WC: med (IQR)	2.40	(2.00-3.00)	1.00	(0.00-1.60)	0.00	(0.00-0.30)	H(2)= 29.080, p<.001	C>HC p<.001 P>HC p<.001 C>P p=.005	d=3.30 d=1.14 d=1.06
EDEQ-EC: med (IQR)	1.40	(0.40-3.40)	0.40	(0.20-0.60)	0.00	(0.00-0.10)	H(2)= 24.656, p<.001	C>HC p<.001 P>HC p<.001 C>P p=.023	d=2.83 d=1.23 d=1.03
BDI: med (IQR)	7.00	(6.00-10.00)	8.00[a]	(4.75-14.50)	4.00	(2.50-6.00)	H(2)= 10.462, p=.005	C>HC p=.015 P>HC p=.004 C=P p=.982	d=0.96 d=0.96 d=0.00
STAI-S: med (IQR)	48.00	(26.00-53.00)	36.00	(29.00-40.00)	28.00	(23.50-34.00)	H(2)= 10.169, p=.006	C>HC p=.009 P>HC p=.013 C=P p=.200	d=1.39 d=0.84 d=0.42

Note. Missing data: [a]n=1

8.10.3. Infant Characteristics

Descriptive statistics relating to infant characteristics are presented in Table 16. The majority of the sample of infants were born at term and were breastfed. No significant differences were found between groups in birth weight. Gender distribution was equal across groups.

Table 16. Infant characteristics of mothers with active and past eating disorders versus healthy controls. (ED current: active eating disorder; ED Past: past eating disorder; HC: Healthy Control)

	ED current=15	ED past=20	HC=28	Test Statistic
Gestational weeks: med (IQR)	40.00[d] (38.43-41.14)	40.36[e] (39.82-41.14)	40.57[b] (39.50-41.07)	H(2) =1.107, p=.575
Birth weight (kg): med (IQR)	3.55[d] (3.17-4.31)	3.40[a] (3.12-3.82)	3.22[c] (2.97-3.43)	H(2) =3.360, p=.186
Gender: n (%)	Boy 47% Girl 53%	Boy 45% Girl 55%	Boy 68% Girl 32%	X^2 (2)=3.099, p=.212
Feeding: n (%)	Breastfed 73% Bottle-fed 7% Breast and Bottle fed 20%	Breastfed 70% Bottle-fed 3% Breast and Bottle fed 3%	Breastfed 86% Bottle-fed 0% Breast and Bottle fed 14%	X^2 (2)=4.773, p=.311

Note. Missing data: [a]n=1; [b]n=2; [c]n=3; [d]n=4; [e]n=6.

8.10.4. Newborn behaviour

Descriptive statistics relating to newborn behaviour are presented in Table 17. Higher scores indicate more optimal cluster scores, apart from Reflexes where higher scores suggest more abnormal reflexes.

Infant Autonomic Stability differed significantly by group. Infants of mothers with a current ED had significantly poorer autonomic stability compared to infants of mothers with no ED history, as shown by the lower score which indicates poorer performance. This remained marginally significant after adjusting for multiple comparisons using the Bonferroni correction, a score of $p<.017$ was needed to indicate statistical significance. No other significant differences were found between groups.

Table 17. Newborn behaviour in offspring of mothers with active and past eating disorders versus healthy controls. (ED current: active eating disorder; ED Past: past eating disorder; HC: Healthy Control)

	Current N=15		Past N=20		HC N=28		Test Statistic
Orientation: mean (sd)	6.53	(1.56)	6.44	(1.75)	6.74	(1.49)	F(2, 62) =.221, p=.802
Motor: mean (sd)	5.12	(1.11)	5.43	(0.90)	5.59	(0.73)	F(2, 62) =1.360, p=.265
Regulation: mean (sd)	5.68	(0.97)	5.68	(1.59)	5.89	(1.08)	F(2, 62) =.224, p=.800
Autonomic: mean (sd)	5.71	(1.20)	6.13	(1.25)	6.73	(0.93)	F(2, 62) =4.445, p=.016*
Range: med (IQR)	3.5	(2.75-4.00)	3.75	(3.25-4.38)	3.63	(3.50-4.18)	H(2) =.751, p=.687
Reflexes†: med (IQR)	2.00	(1.00-4.00)	1.00	(0.00-3.75)	1.00	(0.00-3.00)	H(2) =2.137, p=.344

† Suboptimal scores are higher.

*Post-hoc test: Current ED > HC, *p*= .017

8.10.5. Mother to Infant Bonding in the newborn period

Descriptive statistics relating to mother-to-infant bonding are presented in Table 18. There was no significant difference by diagnostic group on the total score of MIB.

Table 18. Mother feelings towards newborn infant in mothers with active and past eating disorders versus healthy controls. (ED current: active eating disorder; ED Past: past eating disorder; HC: Healthy Control)

	Current N=4		Past N=9		HC N=8		Test Statistic
Bonding	9.00	(8.25-9.00)	9.00	(8.00-9.50)	9.00	(7.25-9.00)	H(2)=.471, p=.790

8.10.6. Correlations

Correlations were performed between newborn behaviour and Mother-to-Infant-Bonding. There was a positive correlation between the Orientation cluster and MIB (r = .454, p= .039); better newborn Orientation was related to poorer MIB. Additionally there was a positive correlation between Range of State cluster and MIB (r = .439, p= .049); better newborn Range of State was related to poorer MIB.

8.10.7. Regressions: Maternal psychopathology and newborn behaviour

Unadjusted multiple regression analysis was used to determine whether maternal psychopathology (EDEQ, BDI and STAI-S) during pregnancy could predict newborn behaviour. The results from these analyses are presented in Table 19.

The model for the Autonomic cluster [F (3, 50) 4.323, p=.009 and explained 21% of the variance] and the Motor cluster were significant [F (3, 50) 3.592, p=.020 and explained 18% of the variance]. The model for the Orientation cluster [F (3, 50) .932, p=.432 and explained 05% of the variance] and the Range of State cluster were non-significant [F (3, 50) .462, p=.710 and explained 03% of the variance].

Table 19. Examination of the impact of maternal psychopathology on newborn behaviour: linear regression analysis.

	Unstandardised coefficients		Standardised coefficients	T	Significance
	B	Standard Error	B		
Orientation cluster					
(Constant)	5.631	.793		7.098	.000
EDEQ-T	-.388	.267	-.245	-1.455	.152
BDI	.007	.044	.032	.169	.866
STAI-S	.032	.028	.221	1.146	.257
Motor cluster					
(Constant)	6.024	.410		14.704	.000
EDEQ-T	-.308	.138	-.350	-2.233	.030
BDI	.007	.023	.053	.301	.765
STAI-S	-.013	.015	-.154	-.857	.396
Automatic Cluster					
(Constant)	7.382	.518		14.260	.000
EDEQ-T	-.307	.174	-.272	-1.763	.084
BDI	-.012	.029	-.071	-.410	.683
STAI-S	-.020	.018	-.188	-1.065	.292
Range of State Cluster					
(Constant)	3.836	.366		10.470	.000
EDEQ-T	.124	.123	.172	1.008	.318
BDI	.006	.020	.058	.303	.763
STAI-S	-.011	.013	-.162	-.830	.410

Note: EDEQ-T: Eating Disorder Examination Questionnaire; BDI: Beck Depression Inventory; STAI-S: State Trait Anxiety Inventory: State.

8.11. Discussion

The aim of this study was to examine newborn behaviour and mother-newborn bonding in mothers with ED. An additional aim was to investigate the relationship between maternal psychopathology and newborn behaviour.

8.11.1. Newborn automatic stability

Our first hypothesis was that newborns of mothers with a current ED would have suboptimal scores on the BNBAS compared to newborns of mothers with no ED and to newborns of mothers with a past ED. In line with our hypothesis we found that newborns of mothers with a current ED had significantly poorer levels of Autonomic Stability (e.g. more tremulousness and startles and poorer

lability of skin colour) compared to newborns of mothers with no ED. We proposed that greater maternal psychopathology would be associated with less optimal infant development. In support of this hypothesis we found that greater maternal psychopathology significantly predicted Autonomic Stability and Motor Organisation (e.g. general tone, motor maturity, pull-to-sit, and defensive and activity level).

The finding that newborns of mothers with a current ED had poorer levels of autonomic instability is consistent with literature suggesting that the children of parents with a psychological disturbance are an increased risk of a disturbance themselves (Garmezy, 1996; Rutter & Quinton, 1984; Rutter, 1989). Previous literature has commented that the children of mothers with ED in particular are at an increased risk of adverse developmental outcomes (e.g. Park et al., 2003). Our findings extend those that have already been reported concerning the link between maternal mental health and newborn behaviour. Neonates who were exposed to high levels of maternal depression, anxiety and stress during pregnancy showed Autonomic instability (Goodman et al., 2011; Oyemade et al., 1994). Chronicity of maternal depression was significantly associated with the Autonomic system, as length of depression increased, Autonomic stability became poorer (Goodman et al., 2011).

It is possible that newborn behaviour is shaped by the earlier interactions between maternal mental health and foetal development (e.g. Godfrey & Barker, 2001; Barker, 1998; Barker, Bull, Osmond, & Simmonds, 1990). Maternal ED is proposed to influence offspring development via two pathways, nutritional factors and comorbid psychopathology (Micali et al., 2009). It could be suggested that maternal factors contribute to the development of the newborn's autonomic state and subsequent capacity for social behaviour. According to the Polyvagal Theory (Porges, 1995, 2001, 2003) developmental changes in neural regulation of the Autonomic Nervous System (ANS) facilitates either the expansion or reduction of social expression. It has been argued that maturational changes to the ANS ensure that the infant's basic biological needs are accompanied by abilities to regulate physiological and behavioural state through interactions with another person (Porges & Furman, 2011). Through maturation the infant's dependence on others to regulate physiological state subsides. Infant state regulation may compromise social skills at times of environmental risk.

It is uncertain whether autonomic instability, indicating more physiological responses to stress during the newborn period, is related to autonomic regulation later in infancy. In an additional study from the NEST-p cohort, Easter and colleagues (Easter et al., personal communication) reported that eight week old infants of mothers who had an active ED during pregnancy had more pronounced cortisol response to immunisations. On the following day, morning cortisol response was higher in infants of mothers with a current ED, but not in those who had recovered, compared to control

mothers. Offspring of mothers with an active ED show an increased physiological response to stress both during the newborn period and later in infancy.

8.11.2. Mother-infant bonding

Our second hypothesis was that mothers with a current ED would experience more problems with mother-infant bonding compared to those who have recovered from an ED and HC. The second hypothesis was not supported, as women with an ED history and women with no ED reported similar levels of MIB around the newborn period. We predicted that greater maternal psychopathology would be associated with less optimal bonding. Correlations showed that newborn behaviour was linked with maternal feelings about her newborn, better Orientation and Range of State in newborns was associated with poorer mother-to-infant bonding.

In contrast to previous literature, we found that maternal-infant bonding was similar between women with an ED history compared to those without an ED. It had been argued that maternal ED interferes with mother-infant bonding during the postpartum period (Astrachan-Fletcher et al., 2008). Earlier work with women who were pregnant, showed that ED status was linked with problems with maternal attachment to fetus (Foster et al., 1996; Lai & Tang, 2008). Our finding is inconsistent with reports of mother-infant bonding in depression. Maternal depressive symptoms have been reported to be related to problems with mother-infant bonding (Moehler, Brunner, Wiebel, Reck, & Resch, 2006). The differences emerging in reports of mother-infant bonding could be related to the timing of the measurement, as attachment to fetus (Foster et al., 1996; Lai & Tang, 2008) could be quite different to bonding with newborn.

We found that newborn behaviour, including Orientation and Range of State, related to mother-infant bonding. In particular more optimal scores on Orientation and Range of State clusters were associated with less optimal bonding between mother and infant. There may be several explanations for this trend. The first explanation may be related to measurement bias, newborn behaviour was assessed by independent researchers prospectively while mother-infant bonding was rated by mothers retrospectively. Maternal reports may be associated with an increased level of bias (e.g. perceived maternal coping, parity, current bonding with newborn). The second explanation could be linked with maternal readiness to engage with newborn, as increased newborn ability and readiness to attend and interact with environmental stimuli may place increased demands on maternal resources to remain available for interaction.

It is possible that the BNBAS is not sensitive enough to detect the infant's full capacity for emotional development, it has relatively moderate-low test re-test reliability, given that the infant is progressively maturing. Emerging studies document altered temperamental and emotional styles in the offspring of mothers with ED. The offspring of mothers with ED were rated as more 'fussy' and 'difficult' aged 6 months (Zerwas et al., 2012) higher in negative affect (e.g. sadness, crying, irritability) aged 5 years, compared to offspring of mothers with no ED (Agras et al., 1999). The offspring of mothers with ED showed difficulties internalising and externalising compared to children of mothers with no ED (Cimino et al., 2013). Gender appears to differentially influence emotional development in the offspring of people with ED. Girls of mothers with AN show more emotional, conduct and hyperactivity disorders compared to boys of mothers with AN or offspring of healthy mothers. While girls of mothers with BN are more likely to show hyperactivity and boys of mothers with BN to show emotional and conduct disorders (Micali, Hagberg, et al., 2013). These traits observed in the offspring of mothers with ED suggest that infant's emotional development may be more intertwined with ability to interact with others.

8.11.3. Strengths and limitations

The main strength of this study is that it is the first to investigate newborn behaviour in a sample of women with an active and past ED. Another advantage of the study was inclusion of a battery of well validated clinical instruments, which included the BNBAS as a measure of newborn functioning. Lastly the prospective design of the study allowed for associations to be examined between pregnancy and the postnatal period.

This study contained a number of limitations. The main limitation was the small sample size and attrition, especially for the postnatal bonding questionnaire. A further limitation was the ability to compare maternal ED subtype differences. The BNBAS manual suggests that maternal nutrition during pregnancy is important for newborn functioning. The third shortcoming was the variability in days of testing the newborn. The BNBAS has been shown to have low test-retest reliability; due to the rapid changes occurring during the newborn period older newborns might have been showing superior performance.

8.11.4. Clinical implications

Newborns of mothers with a current ED showed a marginally exaggerated response to stress, as indicated by their score on the Autonomic Stability cluster of the BNBAS, compared to newborns of

mothers with no ED history. This finding has implications for the caregiving of infants who are particularly sensitive to stress. It is suggested that caregivers have an important role in being able to contain and sooth negative affective infant behaviour, which can be bought about through attending to infant facial expressions and vocalisations (Brazelton et al., 1974). Caregiving practices which involve promoting close mother-infant contact (e.g. Weller & Feldman, 2003), calming infant by exposing them to familiar versus unfamiliar odors (e.g. Goubet, Strasbaugh & Chesney, 2007) and left cradling the infant (Sieratzki & Woll, 2002) are suggested to be of benefit for soothing infants.

8.11.5. Conclusion

This was the first study to prospectively examine newborn behaviour in mothers with a current and past ED during pregnancy. Newborns of mothers with a current ED showed marginally more autonomic dysregulation, suggesting that they have an increased response to stress. Maternal report of mother-to-infant bonding was similar between mothers with ED compared to no-ED. Newborn readiness to engage with others was related to poorer mother-to-infant bonding. These findings might have implications for caregiver interactions with newborn.

Chapter 9

General discussion and clinical implications

9.1. Chapter Overview

The aim of this chapter is to provide a summary of the main findings of the investigations presented in the thesis. The findings will be discussed in relation to the aims and objectives of the studies and with reference to prior literature in the area. The results derived from the studies will be integrated into the C-IMM model of ED (Schmidt & Treasure, 2006). The main strengths and limitations of the thesis will be summarised and recommendations for future research will be made. The implications for treatment will be considered.

9.2. Summary of findings

The overall aim of the present thesis was examine the associations between ED and socio-emotional processing within the context of the C-IMM (Schmidt & Treasure, 2006).

9.2.1. A systematic review and meta-analysis of the National Institute of Mental Health's Research and Domain Criteria Project 'Systems for Social Processes' in eating disorders

The NIMH's RDoC project outlined a novel conceptualisation of diagnosis, which involved the dimensions of observable behaviours and brain functions. The aim of the study presented in Chapter 3 was to synthesise the literature according to the NIMH RDoC's 'Systems for Social Processes' using a systematic review and a meta-analysis. Overall the findings from the meta-analyses suggest that individuals with ED have difficulties across a range of constructs/subconstructs of social processing with a moderate to large ES. Impairments in social functioning were noted in (a) 'Affiliation and Attachment', with insecure attachment (d=1.31), perceived low parental care (d=.51) and high parental overprotection (d=0.29); (b) 'Social Communication', with poor facial emotion recognition (d=.44); (c) 'Perception and Understanding of Self', with low agency (d=.39), negative self-evaluation (d=2.27) and high alexithymia (d=.66); (d) 'Perception and Understanding of Others' difficulties understanding mental states of others (d=1.07); (e) 'Social Dominance' social inferiority (d=1.08). Findings from the studies described in the systematic review lend further support for these results. The findings from the review provide further support for the integration of social factors in explanatory models of both causal and maintaining factors for ED (Schmidt & Treasure, 2006; Treasure et al., 2012; Treasure & Schmidt, 2013).

9.2.2. Self-concept in Anorexia Nervosa

Chapter 4 investigated the role of self-concept in AN. Cognitive theorists of AN suggest that individuals with the disorder have a negative concept about the self, which could be related to the maintenance of the disorder (Stein, 1996). These core self-beliefs could perpetuate negative automatic thoughts about personally referent information. Engaging in behaviours such as self-criticism and attending to only negative information could serve to reduce these negative attitudes towards the self and be reinforcing. People with AN are reported to be highly perfectionistic, overly concerned with making mistakes and are self-critical when evaluating performance in the context of others. They have anomalies in the processing of affective information with personal relevance, such as symptom associated words. This study focused on investigating implicit self-criticism and attitudes towards personally referent information.

Two novel experimental tasks were used to test the hypotheses, the implicit self-criticism task and the LDT. The first hypothesis was that women with AN would be more self-critical than HC and high self-criticism would predict low levels of perceived social support. The second hypothesis was that women with AN would be slower at responding to positive and negative personally-referent words compared to HC and slow response to personally-referent words would correlate with motivational tendencies. Surprisingly the first hypothesis was not supported. Women with AN had similar levels of implicit self-criticism to HC. Low levels of perceived social support were not found to be a correlate of high self-criticism. The second hypothesis was not supported. Women with AN generally took longer than HC to respond to both positive and negative personally relevant words, negative general words and neutral words, although this was to a non-significant extent. Behavioural tendencies were not found to be correlates of attitudes towards personally referent words.

The results were discussed in relation to implicit versus explicit levels of processing and previous experimental tasks which had used lexical stimuli. The finding that people with AN are not overly self-critical contradicts earlier work in the area. The implicit self-criticism task was used in a small sample of women with AN. Women with AN were found to be more overly self-critical than controls (Perkins, personal communication). Based on a self-report measure, individuals with ED rated themselves as being overly self-critical (Lehman & Rodin, 1989). The finding that women with AN had similar responses to personally referent words on the LDT is inconsistent with earlier work. Smith and colleagues (Smith, Joiner & Dodd, 2014) found that women with AN responded more quickly to ‘beautiful’ and ‘ugly’ than controls did. This suggests that those with AN may have a selective processing bias towards certain disorder related word categories rather than to those related to self-concept.

9.2.3. Social-emotional processing in Eating Disorders

The interpersonal functioning model of ED suggests that social maladjustment plays a role in the maintenance of ED psychopathology (e.g. Schmidt & Treasure, 2006). Perception and response to emotional information is important for interpersonal communication and affiliation (Hatfield, 1992; Lakin & Chartrand, 2003). Positive and negative emotional signals are associated with different response styles (Calder, Young, Keane, & Dean, 2000; Calvo & Lundqvist, 2008; Tottenham et al., 2009). Key components of interpersonal functioning, such as attentional processing, identification of others' emotion, subjective emotional response and facial expressivity, have been shown to be impaired in ED.

The aim of the study presented in Chapter 5 was to investigate attentional processing, identification of others' emotion, subjective emotional response and facial expressivity in response to photographs and film clips of adults and infants displaying happy, sad or frustrated facial expressions in women with ED compared to HC. A secondary aim was to examine whether social support, low mood and behavioural tendencies were correlates of these aspects of social emotional processing. Unexpectedly, women with an ED showed a similar pattern of selective attention to emotional displays of happiness and sadness as women with no-ED. In line with our hypothesis, women with AN had a reduced ability to identify infant happiness compared to HC. Surprisingly women with AN rated their subjective emotional response as higher to infant sadness. In accordance with our hypothesis, we found that women with AN engaged in less facial mirroring while viewing an adult and an infant displaying happiness in a film clip compared to HC. Surprisingly women who had recovered from AN did not differ from HC. Women currently ill with AN turned away more often from displays of happiness and frustration compared to HC. Women who had recovered from AN were similar to HC in terms of facial mirroring and avoidance. An increase in facial avoidance of happiness was found to correlate with less social support. This association might be a potential mechanism to explain decreased friendship networks in ED. Also, increased symptoms of depression correlated with reduced facial mirroring of happiness.

The finding that women currently ill with AN were found to be less able to identify infant happiness is in line with the earlier work which shows that people with AN reported social anhedonia (Tchanturia, Davies, Harrison et al., 2012). We found that women with AN rated subjective response to infant sadness as higher than HC, this finding is supported by earlier reports of an amplified experience of negative affective photographs (Nandrino et al., 2012). The finding that people with AN have low levels of facial emotional expressivity builds upon results from earlier studies which use emotional and non-emotional paradigms (Claes et al., 2012; Davies et al., 2011; Rhind et al.,

submitted). This appears to be an effect of starvation as attenuated facial expression was not observed in those who had recovered.

9.2.4. Identification of infants' emotion in women with eating disorders during late pregnancy: A preliminary study

Maternal sensitivity is integral for mother-infant relationships (Owren & Bachorowski, 2003; Bowlby, 1969; Soltis, 2004). It has been recently suggested that maternal sensitivity develops during late pregnancy and is associated with neurological and neuroendocrine systems increasing preparedness for maternal response (Pearson et al., 2012). The aim of the study presented in Chapter 7 was to investigate the perception of the emotional intensity of infant displays during late pregnancy in women with ED compared to HC. The hypothesis was not supported, however we found that maternal psychopathology predicted response to infant sadness. This finding is in line with reports that people with ED are sensitive to negative affect (e.g. Nandrino et al., 2012) and they have anomalies in sensory sensitivity (Zucker et al., 2013), for example in sensation seeking and avoidance.

9.2.5. Caregiver-interactive system in women with eating disorders: newborn behaviour and mother infant-bonding

The offspring of mothers with ED show difficulties with temperamental and emotional development (Park et al., 2003). Little research has been gathered for offspring social emotional style in the perinatal period, despite reports suggesting that people with ED show difficulties with attachment to the fetus (Astrachan-Fletcher et al., 2008). The aim of the study discussed in Chapter 8 was to investigate whether maternal prenatal ED was linked with both poorer newborn behaviour and with less than optimal mother-newborn bonding. We found evidence to support our hypothesis. Newborns of mothers with a current ED had significantly poorer Autonomic Stability (e.g. more tremulousness and startles and poorer lability of skin colour) compared to newborns of mothers with no ED. Greater maternal psychopathology was found to significantly predict Autonomic Stability and Motor Organisation (e.g. general tone, motor maturity, pull-to-sit, and defensive and activity level). The second hypothesis was not supported, as women with an ED history and women with no ED reported similar levels of Mother to Infant Bonding around the newborn period. Correlations showed that newborn behaviour was linked with maternal feelings about her newborn, better Orientation and Range of State in newborns was associated with poorer mother-to-infant bonding.

This finding that newborns of mothers with a current ED had significantly poorer Autonomic Stability is consistent with reports of autonomic instability in the newborns mothers with depression and anxiety (e.g. Goodman et al., 2011; Oyemade et al., 1994). The finding that mother-to-infant bonding was similar between mothers with ED and controls was inconsistent with suggestions that maternal ED interferes with mother-infant bonding during the postpartum period (Astrachan-Fletcher et al., 2008).

9.3. Integration of findings into the Cognitive Interpersonal Maintenance Model of eating disorders

An overview of the C-IMM of ED (Schmidt & Treasure, 2006) was provided in Chapter 1. According to the model social and emotional factors, specifically intra- and interpersonal components are related to the maintenance of ED. The model described how four areas contributed to continuation of symptoms: cognitive style; social-emotional style; pro-anorexia thinking and interpersonal factors (social emotional problems in ED and response from others). In an updated version of the model, Treasure and Schmidt (Treasure & Schmidt, 2013) propose that some of the social emotional traits present in patients are inherited vulnerabilities and are present in family members. Five testable hypotheses were derived largely from the Interpersonal Factors area of the model.

The C-IMM describes that problems with social-emotional processing have been implicated in the development and maintenance of ED (Arcelus, Haslam, Farrow, & Meyer, 2013; Ardovini, 2002; Astrachan-Fletcher, Veldhuis, Lively, Fowler, & Marcks, 2008; DeJong et al., 2013; Kuipers & Bekker, 2012; O'Kearney, 1996; Nowakowski, McFarlane, & Cassin, 2013; Oldershaw et al., 2011; O'Shaughnessy & Dallos, 2009; Rieger et al., 2010; Tasca, Ritchie, & Balfour, 2011; Treasure et al., 2012; Treasure & Schmidt, 2013; Ward, Ramsay, & Treasure, 2000; Zachrisson & Skarderud, 2010; Zucker et al., 2007). The first study presented in Chapter 3 synthesised the literature in social processing in ED according to the RDoC project criteria. Our first hypothesis was supported as people with ED showed varying degrees of problems across a range of social constructs.

Views about the self are an important aspect of social-emotional processing. The C-IMM (Schmidt & Treasure, 2006) describes how beliefs about self-worth and anorexia are highly intertwined. Previously it has been argued that a negative self-concept is related to the maintenance of AN (Stein, 1996). The second study presented in Chapter 4 examined implicit self-criticism and the processing of negatively affective words about the self using experimental tasks in women with AN compared to HC. Our second hypothesis was not supported, as women with AN had similar levels of implicit self-criticism and the processing of negatively-affective words as women without AN. Also perceived social support and behavioural inhibition were not found to be correlates of self-concept.

Social-emotional difficulties are described within one part of the Interpersonal Factors section of the C-IMM (Schmidt & Treasure, 2006). The study presented within Chapter 5 tested the hypothesis that people with ED would show specific anomalies in response to positive and negative expressions, more so towards infant cues than adult cues. This hypothesis was marginally supported. Those with AN showed a decreased ability to identify infant happiness and an amplified experience of subjective negative affect in response to infant sadness compared to HC. They also showed reduced facial mirroring of infant and adult happiness and more instances of turning away from frustration.

As we found anomalies in social-emotional processing towards infant cues in Chapter 5, the study presented within Chapter 7 tested the hypothesis that mothers with ED would show impairments in maternal sensitivity towards infant facial stimuli, rating them as less intense than healthy women. This hypothesis was not supported as women with ED had similar identification of infant's emotions as HC.

The Interpersonal Factors section of the C-IMM (Schmidt & Treasure, 2006) suggests that people with ED have problems with social-emotional processing. There has been suggestion that the offspring of people with a psychological disturbance are at an increased risk of disturbance themselves (e.g. Rutter & Quinton, 1984; Rutter, 1989). In the updated version of the C-IMM, Treasure and Schmidt (Treasure & Schmidt, 2013) suggest that there are some social emotional traits present in patients which are inherited vulnerabilities and are present in family members. The study shown in Chapter 8 examined the hypothesis that newborns of mothers with ED will have poorer behaviour compared to newborns of mothers with no ED. This hypothesis was partially supported as newborns of mothers with a current ED had more autonomic instability compared to newborns of mothers without ED. We tested the hypothesis that mothers with ED would rate lower levels of MIB. Unexpectedly we found that ratings of mother to infant bonding were similar between mothers with and with a history of an ED. The findings from this Chapter provide information about the role of maternal ED status on various aspects of newborn functioning, including social behaviour as measured by the Orientation cluster of the BNBAS, and MIB. Although socio-emotional traits were not directly assessed between mother and infant, the findings from the study can be used to broadly highlight the perinatal period as an important area for future research and integration within the C-IMM. It is particularly to address this area of research given that there is a growing body of literature which shows that the offspring of mothers with an ED have altered temperamental and emotional styles (Agras et al., 1999; Cimino et al., 2013; Micali et al., 2013; Zerwas et al., 2012).

The combined findings shed light on the specific nature of social-emotional processing in ED. Particular aspects of the thesis hypotheses were supported and highlighted key weaknesses in

social-emotional processing, although the general majority were not. The C-IMM (Schmidt & Treasure, 2006) could be updated to integrate these findings within the section of Interpersonal Factors to demonstrate that individuals with ED do not necessarily have general impairments in social-emotional processing; however there were specific examples where anomalies were present. It is possible that some aspects of social-emotional processing play a greater role in symptom maintenance than others. The main difference between the original and revised C-IMM is the discussion of social-emotional traits being present in patients as well as family members. In light of the finding from this thesis concerning newborn autonomic instability, further discussion could be made about aspects of physiological response to stress across generations. The thesis concentrated on self-report and behavioural features rather than other forms of social-emotional processing (e.g. neurological). The part of the Interpersonal Factors which was not tested was response from others, further investigation into this topic would be required to address this. It is possible that the findings from this thesis can be used to inform the Interpersonal Functioning Model by Arcelus (Arcelus et al., 2013).

Recently Arcelus and colleagues (Arcelus et al., 2013) proposed the interpersonal functioning model of ED which suggested that social maladjustment, including social inhibition and lack of social support, maintains ED psychopathology. The model states that people with ED are more likely to avoid emotional expression, especially in the context of negative evaluation, which could deter attempts to seek social support. The authors suggest that particular interpersonal traits which contribute to social maladjustment differ in individuals who restrict compared to those who binge/purge. Fear of negative evaluation, negative attitude towards the expression of emotion and avoidance of expression contributes to interpersonal sensitivity, low self-esteem and social anxiety in individuals who restrict. In contrast, difficulties in trusting others is related to negative interactions and conflicts with others, which results in interpersonal sensitivity, social anxiety, fear of intimacy and poor emotional support in individuals who binge/purge. Interpersonal difficulties are suggested to be more common in individuals who restrict. Maladaptive childhood attachment is thought to contribute to the development of interpersonal problems in those who restrict.

Overall the findings from the studies presented in the thesis lend further support for the role of various aspects of the interpersonal functioning in the maintenance of ED (Arcelus et al., 2013). The findings from the systematic review presented in Chapter 3 support the proposition of social maladjustment in ED. Those with ED were found to have poorer ‘Social Communication’, ‘Perception and Understanding of Self’ and ‘Perception and Understanding of Others’. Crucially people with ED

were found to show high levels of social inferiority, a characteristic which relates to the underlying notion within the model regarding fear of negative evaluation and social anxiety.

The model mentions that low social support and difficulty in accessing social support are involved in the maintenance of the disorder. There were inconsistent findings regarding social support in the thesis. The results in Chapter 4 showed that low social support was not related to self-criticism, while the findings in Chapter 5 showed that an increase in facial avoidance of happiness correlated with less social support.

The interpersonal functioning model states that avoidance of emotional expression and social inhibition are involved in the maintenance of ED. Women with AN were found to show anomalies in social processing in Chapter 5 which could relate to these beliefs about and difficulties in social functioning. Compared to HC, women with AN had a reduced ability to identify infant happiness, they rated their subjective emotional response as higher to infant sadness, they engaged in less facial mirroring while viewing an adult and an infant displaying happiness in a film clip and they turned away more often from displays of happiness and frustration.

The findings from the systematic review in Chapter 3 provide additional support for the argument that maladaptive childhood attachment plays a role in the psychopathology of ED, people with ED were found to have insecure attachment and they perceived low parental care and high parental overprotection. However, it is important to state that the results in Chapter 8 showed that MIB was not disrupted in mothers with ED and their offspring. The findings in Chapter 5 provided no support for the expected relationship between maladaptive childhood experiences and socio-emotional functioning. Early adverse experience was not found to predict emotional response to either infant or adult emotional displays.

9.4. Future research

There are several areas for future research which can be derived from the investigations presented in this thesis.

The review in Chapter 3 showed that there was evidence for alterations in ‘Affiliation and Attachment’, ‘Social Communication’, ‘Perception and Understanding of Self’, ‘Perception and Understanding of Others’ and ‘Social Dominance’ in ED. This evidence was gathered from self-report and behavioural instruments, thus expansion of the study of these areas using additional units of

analysis within the RDoC framework (e.g. genes, molecules, cells, circuits) is important. There was too little evidence to consider for the areas of 'Reception of non-facial communication', 'Production of non-facial communication', 'Animacy' and 'Action perception'. It will be important to include these areas in future study in better inform models of difficulties with social emotional functioning in ED, preferably with examination of multiple units of analysis (e.g. genes, molecules, cells, circuits, behavioural, self-report).

The investigation presented in Chapter 4 showed that women with AN were not self-critical at an implicit level of functioning. This finding is in contrast to what has been found by self-report where women with ED reported more self-critical thoughts than controls did (Lehman & Rodin, 1989). Future research investigating self-critical thoughts at multiple levels of processing will be important, as negative self-concept has been hypothetically implicated in the development and maintenance of symptoms of AN (Stein, 1996). Expanding on the understanding of the relationship between self-critical thoughts and low self-esteem in AN will be pertinent, as the relationship between self-criticism and the over-evaluation of shape and weight was reported to be partially mediated by low self-esteem and depressive symptoms in patients with BED (Dunkley & Grilo, 2007). The second investigation in Chapter 4 showed that women with AN had similar responses to personally referent words than women with no ED. This finding is in contrast to that found in a subsequent study using an LDT, which showed that women with AN responded quicker to words which had connotations of emaciation (e.g. beauty and ugly words) (Smith, Joiner & Dodd, 2014). Implicit processing in AN appears to be different for words with emotional content compared to those associated with the illness. Further replication of LDT with an increased variety of stimuli categories of words is required to understand the specificity of implicit processing within the illness.

The investigation presented in Chapter 5 highlights that women with ED had various anomalies in the identification of emotion, subjective emotional response and facial expressivity in response to emotional displays by adults and infants. An advantage of this study was the inclusion of those women who had recovered from an ED. Distinct difficulties in aspects of registration, emotional experience and facial expressivity were observed only in those currently ill, while there were trends to suggest that alterations in attentional processing were present both in the current and recovered state. Replication of these measures with larger sample sizes is important to further extrapolate state and trait similarities and differences in social emotional processing, in particular in those recovered from BN. Additionally including biological (e.g. cortisol, oxytocin) and physiological measures (e.g. skin conductance, eye gaze) will be important to build upon these findings. Longitudinal study of these aspects of social emotional processing is important to inform prognosis.

The findings from a single study showed that adolescents currently ill with AN had attenuated facial expressivity compared to healthy adolescents (Rhind et al., submitted). It will be important to extend these findings to attentional processing and registration as potential markers of early dysfunction in adolescent samples in order to inform clinical decisions.

The examination described in Chapter 7 provided tentative evidence to suggest that a history of a maternal ED was associated with an increase in maternal sensitivity towards infant displays of emotion in pregnancy. A replication of this study with larger sample sizes in both the active and past ED condition is important to understand whether these findings are specific to the state or trait aspects of the illness. The study of the biological (e.g. oxytocin production and function) and psychological factors (e.g. pregnancy related anxieties) contributing to this elevated maternal sensitivity is important for improving understanding of this response style. A follow-up assessment of postnatal maternal sensitivity and mother-infant interaction is crucial to understand whether increase in prenatal maternal sensitivity is beneficial for the mother-infant relationship. Understanding the mechanisms involved in pre and postnatal maternal sensitivity and the mother infant relationship has important clinical implications for the role of maternal processing.

The investigation presented in Chapter 8 showed that newborn infants of mothers with a current ED were more sensitive to environmental stress than newborns of mothers without ED. A follow-up assessment of stress response in these infants is important to understand the long-term consequences for the heightened stress response on development and health. The study by Easter and colleagues (Easter, personal communication) conducted in the same sample as those in the current study, reported that eight week old infants of mothers who had an active ED during pregnancy had elevated cortisol response to immunisations. Investigating the association between newborn and infant stress response will be the first step to understanding whether the offspring of those with a current ED are particularly vulnerable to exaggerated stress response and to consider the impact of this on mother and offspring relationship. Potential mechanisms that require further investigation in this area are HPA and CNS function, as well as the contribution of maternal ED status.

9.5. Clinical implications

The National Institute for Clinical Excellence (NICE, 2004) UK guidelines for ED do not suggest a particular treatment for difficulties with social emotional functioning. A range of treatment options are suggested to manage ED, such as the use of psychological therapy for the treatment of AN and

Cognitive Behavioural Therapy (CBT) for the treatment of BN. Consideration of the individual's social needs is made, although the outcomes of treatment for ED on social emotional processing are unspecified. The investigations presented in this thesis contribute to the evidence base for the inclusion of interventions which target particular aspects of problems with social and emotional processing which maintain the illness. Based on the findings from this thesis and previous evidence in the field, numerous clinical interventions are described below. This thesis is particularly timely, as the next review date for NICE UK guidelines for the treatment of ED is January 2014. Elements of social-emotional processing are suggested to be common to other psychiatric illnesses (Meyer-Lindenberg & Tost, 2012).

9.5.1. Emotion Focused Therapy

In the review presented in Chapter 3, we reported that people with ED showed insecure attachment to a large extent. Emotion-Focused Therapy (EFT) could be offered alongside family therapy to address issues in the family relationships. The key principal of EFT is that emotion is essential in the construction of the self and drives self-organisation (Greenberg, Warwar, & Malcolm, 2010). The individual may find it difficult to cope with emotion if their past emotional displays have been met with inadequate responses from the environment (Haslam, Arcelus, Farrow, & Meyer, 2012). For example family rules surrounding the suppression of anger could precede the suppression of healthy levels of anger. EFT attempts to improve emotional intelligence and support the expression of emotion in an adaptive manner. EFT has been reported to be effective for treatments of adults (Dolhanty & Greenberg, 2009; Dolhanty & Greenberg, 2007) and adolescents with ED (Robinson, Dolhanty, & Greenberg, 2013). The evidence base for EFT is growing and may be of benefit for those individuals who experience emotional 'blocks' that interfere with their ability to recover.

9.5.2. Compassion Focused Therapy

The review presented in Chapter 3 showed that people with ED had negative evaluation to a large extent. Self-compassion therapy could be applied to reframe self-critical thoughts. Goss and Allan (Goss & Allan, 2010) developed a twenty-four session group treatment program, Compassion Focused Therapy for ED (CFT-E), to target high levels of self-criticism, self-directed hostility and shame proneness in adults with ED. This approach is based on psychoeducation and encourages the shift from self-blame towards self-compassion. Evidence in this area suggests that teaching individuals to be more self-compassionate reduces the levels of self-criticism (Gilbert & Procter,

2006). The effectiveness of CFT-E is currently being tested in individuals with ED (Conventry Eating Disorders Service, UK).

9.5.3. Emotion Acceptable Behaviour Therapy.

The literature review presented in Chapter 3 showed that individuals with ED had difficulties with understanding emotions in others. Emotion Acceptable Behaviour Therapy (EABT) may be of use to target this feature of the disorder. EABT includes education about the function of emotions and the benefits of emotional awareness (Wildes et al., 2014). It also contains interventions to decrease emotional avoidance and encourage resumption of valued relationships outside of the ED. Pilot data suggests that EABT used across 24 sessions is beneficial for treatment of symptoms of adults and adolescents with AN (Wildes & Marucs, 2011).

9.5.4. Attention Bias Modification

The literature review shown in Chapter 3 showed that people with ED are sensitive to social dominance. A novel approach to the treatment of ED may be Attentional Bias Modication Treatment (ABMT) (Renwick, Campbell, et al., 2013). ABMT involves the modification of maladaptive attentional patterns to those which are more adaptive. As described in Chapter 5, selective attention and heightened vigilance to negative emotional stimuli has been reported in individuals with AN (Cardi et al., 2014; Cardi et al., 2012; Harrison, Sullivan, et al., 2010; Harrison, Tchanturia, et al., 2010). The success of ABMT has been reported in clinical populations such as those with anxiety disorders. A recent meta-analysis showed that ABMT decreased anxiety with a medium effect (Hakamata et al., 2010). ABMT may be used to increase attention to positive affective stimuli and reduce attention paid to negative affective stimuli (e.g. social dominance) may be of benefit for those with ED.

9.5.5. Intranasal oxytocin administration

In the study presented in Chapter 5, individuals with AN were reported to have difficulty in the identification of infant happiness. Emerging literature in the area of intra-nasal oxytocin suggests that it may facilitate emotion recognition. Oxytocin is a neuropeptide which is commonly associated with bonding and attachment behaviours. Oxytocin has been suggested to enhance trust (Baumgartner, Heinrichs, Vonlanthen, Fischbacher, & Fehr, 2008), affiliation (Zak, 2008), secure attachment (Buchheim et al., 2009), improve eye-gaze and empathy (Guastella, Mitchell, & Dadds,

2008) and emotional recognition (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007). People with ED display difficulties with social emotional processing. Treatments including the administration of intranasal oxytocin may be of use to ameliorate these difficulties. Previous research has shown that people with AN have lower levels of nocturnal serum oxytocin (Lawson et al., 2011) and cerebrospinal fluid levels of oxytocin are low during the starvation phase of AN (Chiodera et al., 1991; Demitrack et al., 1990; Lawson et al., 2011). It is suggested that oxytocin levels may normalise with recovery (Frank, Kaye, Altemus, & Greeno, 2000). A recent review synthesised the evidence for altered oxytocin functioning in AN (Maguire et al., 2013). Intranasal oxytocin appears to be of use for the treatment of both social emotional difficulties and problems with disordered eating symptoms. Kim and colleagues (Kim, Park & Treasure, submitted) showed that oxytocin attenuated attentional vigilance to pictures of disgust displays. Also oxytocin increased the vigilance to angry faces in AN. The pilot data reported by Maguire et al. (Maguire et al., 2013) shows that administration of intranasal oxytocin for four weeks reduced eating concern.

9.5.6. Facial feedback and mimicry

In the study described in Chapter 5, women with AN were reported to show diminished facial mirroring compared to women with no-ED to adult and infant displays of happiness. There is scarcity of evidence to enhance facial expression in psychiatric populations. Both electromyographic and mirror feedback have been found to improve voluntary movement of facial expressivity in patients suffering from facial nerve paresis (Ross, Nedzelski & McLean, 1991). Integrating forms of facial feedback may be an efficacious treatment for individuals with ED. Using biofeedback through Playmancer software (Claes et al., 2012) may improve self-awareness of facial expression. Encouraging mimicry of others actions may improve facial expressivity. Mimicry of the six emotions was found to facilitate facial affect sensitivity, compared to the emotional suppression condition in a non-clinical sample (Schneider, Hempel, & Lynch, 2013).

9.5.7. Maternal-infant contact: Touch therapy

In the study presented in Chapter 8, we reported that newborns of mothers with a current ED showed poorer autonomic stability. It is possible that touch therapy may be applied to improve the newborn's ability to organise automatic state. It is understood that maternal-newborn contact is beneficial for the organisation of the offspring's physiological systems. Specifically including those involved in stress reactivity, autonomic functions and sleep patterns. Interventions which promote maternal-infant contact have been described to improve the infant's ability to self-regulate

(Feldman, Weller, Sirota, & Eidelman, 2003; Weller & Feldman, 2003). A recent study reported that Kangaroo Care (KC), which provided maternal-newborn skin-to-skin contact, increased autonomic functioning in preterm newborns as well as maternal attachment behaviour (Feldman, Rosenthal, & Eidelman, 2013). Following a KC intervention, infants showed less negative affect (Feldman et al., 2003). Encouraging touch therapy practises for mothers with ED may reduce infant elevated stress response.

9.6. General strengths and limitations

There were some general strengths and limitations linked to the methodology and results of the studies presented as part of this thesis.

9.6.1. General strengths

The use of multiple study designs, such as cross-sectional and prospective longitudinal, is an advantage for improving understanding of state and trait effects. The use of the prospective longitudinal design allows for the investigation of the comparison between those who have an active or a past ED. The inclusion of the recovered sample overcomes the limits associated with the cross-sectional design. A strength of the thesis is the use of a multi-method approach, for instance the inclusion of self-report, experimental and behavioural instruments, that allowed for a more comprehensive understanding of social emotional processing. The use of both experimental and behavioural instruments provides a more objective understanding of social emotional processing and minimises the bias associated with self-report materials. Experimenter error was minimised where possible, for example the inclusion of a test for inter-rater reliability for facial coding and formal training the administration of the BNBAS. The use of ecologically valid stimuli has advantages for translating the findings into clinical interventions. The investigation of a wide range of interpersonal aspects of social-emotional processing across this thesis permits for the development of treatments to target specific areas of weakness.

9.6.2. General limitations

The majority of women with ED were sampled from specialist services in the United Kingdom and to a lesser extent from the wider community. This limits the representativeness of the sample to those currently engaging in treatment and may not be reflective of the United Kingdom as a whole. The restriction of sampling to females only reduces the generalizability of the findings to males with ED.

The findings in the thesis may not apply to all those with ED, as the majority of the cases studied within this thesis had a diagnosis of AN.

Issues with the sample size were highlighted throughout the thesis and the implications this had on the statistical power were considered. The small sample sizes in several studies and missing data with some aspects of the protocol reduced the ability to formally test models. For example, the grouping of women in the NEST-p studies into those with either active or past ED as it was not possible to group per diagnosis (e.g. AN, BN, BED). Approaches to deal with missing data, such as pro-rating to compute multiple imputations based on the mean value was considered, but were not applied as more than 15% of data were missing for that outcome. This weakened the ability to understand the clinical characteristics of those individuals who had completed the full protocol compared to those that had not. Replication of the studies with larger sample sizes and repeated measures may be required to gain sufficient power to test hypotheses. Detailed information about medication, maternal status and menarche was not requested which prevented the ability to explore the role they played in social-emotional processing.

There were several methodological issues with the tasks employed, in terms of the use of yet to be validated measures (e.g. Implicit self-criticism task) compared to other validated and widely implemented alternatives. There were various issues with the specific elements of some of the task designs related to stimulus exposure time, salience of emotional images presented and the presentation of the film clips once only rather than through repeated trials. The complications which arose when synthesising articles were described in the systematic review (e.g. task variation). . There was no assessment of the quality of the studies included in the systematic review and we found no articles to represent some constructs.. There was a large variability in the age (in terms of days) at which the newborn infant was assessed, this might have had consequences for test-retest reliability since newborn performance on the BNBAS improves with maturation.

There was a largely indirect approach to testing the hypotheses derived from the C-IMM (Schmidt & Treasure, 2006) and some aspects of the model were more ambiguous to test than others. This had implications for the integration of the results into the C-IMM (Schmidt & Treasure, 2006) as hypotheses were not direct. The results were considered within an alternative social-emotional processing model, which focused on interpersonal aspects related to the psychopathology of the illness.

9.7. Sequence of studies

It is important to state the order in which studies presented in the thesis were conducted. The systematic review was not completed until after the experimental studies were finalised or were in the process of finalisation. The sequence in which the studies were produced has a number of theoretical and methodological implications. Had the systematic review been completed before the experimental studies began then the findings from it would have been able to inform the areas of social-emotional processing to subsequently test with the experimental studies. The hypotheses could have directly assessed the area of Social-Emotional Processing in the Interpersonal Factors domain of the C-IMM (Schmidt & Treasure, 2006). The choice of tasks to employ may have differed as result of these changes.

9.8. Concluding remarks

The main aim of this thesis was to examine social-emotional processing in ED within the framework of the C-IMM (Schmidt & Treasure, 2006). The data derived from investigations presented in this thesis contribute to the evidence base which supports the inclusion of specific social-emotional processing problems in the development and maintenance of ED. Several recommendations were made for future work. The clinical implications of the findings were described in relation to treatment for these anomalies in social and emotional processing.

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Appendix

A1. Demographic Questionnaire

Your Date of Birth	
Age	
Sex	Female / Male

Is English your first language?	No / Yes	
What is your ethnicity?	White British White Irish Other White Mixed White and Black Caribbean Mixed White and Black African Mixed White and Asian Other Mixed Chinese Other-: ..... (please specify)	Asian or Asian British – Indian Asian or Asian British – Pakistani Asian or Asian British – Bangladeshi Other Asian Black or Black British – Caribbean Black or Black British – African Other Black

What is the highest level of education you completed?	No qualifications O Level / GCSE A Level / NVQ Diploma / BTEC University Degree Postgraduate Degree Other-: ..... (please specify)
How many years of education have you received? *In England, children usually start school aged 5.*	
What is your current employment status?	Full time Professional Part time Professional Student Retired Sick leave House wife/husband Unemployed Other-: ..... (please specify)
What is your current or most recent occupation? ***If you are unemployed, please indicate for how long you have been unemployed for and what your previous occupation was.***	

What is your marital status?	Single In a relationship Married Divorced Widowed Other-: ..... (please specify)

How many children do you have?	No. of daughters:-	Their age:-
	No. of sons:	Their age:-
Who lives in our household with you? *E.g. mum, brother, friends*		
Are you currently receiving any medication? *Please list all medication including contraceptive pill, herbal remedies or supplements*	No / Yes If yes, please give details:-.....	
Have you ever been diagnosed with a visual impairment?	No / Yes If yes, is this corrected with an aide? (e.g. glasses, contact lenses) No / Yes	
Have you ever been diagnosed with a neurological condition?	No / Yes If yes, please give details:-.....	
Have you ever been diagnosed with a psychiatric condition?	No / Yes If yes, please give details:-.....	
Has anyone in your family been diagnosed with a psychiatric condition?	No / Yes If yes, please give details:-..... ..... What relation is this person to you.....	

IF APPLICABLE	**For how many years have you had an eating disorder?**	
	Have you had to take time off from school or work due to your eating difficulties?	No / Yes If yes, how long in total:-..... ....
	Have you had a previous hospital admission for your condition?	No / Yes If yes, how many:-..... ....

What is your current weight?	How was this measured?.....
What is your current height?	How was this measured?.....
What is the lowest and highest ever weight you have been at this height?	Lowest:- ..... Highest:- .....

Have you consumed caffeine within the last 12 hours?	No / Yes If yes, estimate how much:-..... .....

A2. Eating Disorder Examination Questionnaire

The following questions are concerned with the **past four weeks only (28 days)**. Please read each question carefully and tick the appropriate box.

Please answer all the questions.

On how many days out of the past 28 days…	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you gone for long periods of time (8 hours or more) without eating anything in order to influence your shape or weight?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you tried to avoid eating foods which you like in order to influence your shape or weight?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you tried to follow definite rules regarding your eating in order to influence your shape or weight; for example, a calorie limit, a set amount of food, or rules about what or when you should eat?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you wanted your stomach to be empty?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Has thinking about food or its calorie content made it much more difficult to concentrate on things you're interested in; for example, read, watch TV or follow a conversation?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you been afraid of losing control over eating?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you had episodes of binge eating?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you eaten in secret? (Do not count binges)	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

On how many days out of the past 28 days…	No days	1-5 days	6-12 days	13-15 days	16-22 days	23-27 days	Every day
Have you definitely wanted your stomach to be flat?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Has thinking about shape or weight made it more difficult to concentrate on things you are interested in; e.g., read, watch TV or follow a conversation?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Have you had a definite fear that you might gain weight or become fat?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

Have you felt fat?	0	1	2	3	4	5	6
Have you had a strong desire to lose weight?	0	1	2	3	4	5	6

Over the past 4 weeks (28 days)	**None of the times**	**A few of the times**	**Less than ½ the time**	**Half the time**	**More than ½ the time**	**Most of the time**	**Every time**
On what proportion of times that you have eaten have you <u>felt guilty</u> because of the effect on your shape or weight? (Do not count binges)	0	1	2	3	4	5	6

Have there been any times when you have felt that you have eaten what other people would regard as an unusually large amount of food given the circumstances? 1 No Yes

How many such episodes have you had over the past four weeks?

During how many of these episodes of overeating did you have a sense of having lost control over your eating?

Have you had other episodes of eating in which you have had a sense of having lost control and eaten too much, but have <u>not</u> eaten an unusually large amount of food given the circumstances? 1 No Yes

How many such episodes have you had over the past four weeks?

Have you made yourself sick (vomit) as a means of controlling your shape or weight? 1 No Yes

How many times have you done this over the past four weeks?

Have you taken laxatives as a means of controlling your shape or weight? 1 No Yes

How many times have you done this over the past four weeks?

Have you taken diuretics (water tablets) as a means of controlling your shape or weight? 1 No Yes

How many times have you done this over the past four weeks?

Have you exercised <u>hard</u> as a means of controlling your shape or weight? 1

No Yes

How many times have you done this over the past four weeks?

	Over the past 4 weeks (28 days)	Not at all		**Slightly**		**Moderately**		**Markedly**
1.	Has your weight influenced how you think about (judge) yourself as a person?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
2.	Has your shape influenced how you think about (judge) yourself as a person?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
3.	How much would it upset you if you had to weigh yourself once a week for the next four weeks?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
4.	How dissatisfied have you felt about your weight?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
5.	How dissatisfied have you felt about your shape?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
6.	How concerned have you been about other people seeing you eat?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
7.	How uncomfortable have you felt seeing your body; for example, in shop window reflections, while undressing or taking a bath or shower?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
8.	How uncomfortable have you felt about others seeing your body; for example, in communal changing rooms, when swimming or wearing tight clothes?	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

A3. Depression, Anxiety and Stress Scale

DASS21 *Name:* *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all

1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree, or a good part of time

3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

A4. Oslo Social Support Scale

"In the following I will ask three questions about how you experience your social relationships. I emphasise that I am inquiring about your immediate, personal experience. Choose one of the options I give for each question."	
1) How many people are so close to you that you can count on them if you have serious personal problems (choose one option)?	
1	None
2	1 or 2
3	3-5
4	More than 5
2) How much concern do people show in what you are doing (choose one option)?	
5	A lot of concern and interest
4	Some concern and interest
3	Uncertain
2	Little concern and interest
1	No concern and interest
3) How easy is it to get practical help from neighbours if you should need it (choose one option)?	
5	Very easy
4	Easy
3	Possible
2	Difficult
1	Very difficult

A5. Behavioural Inhibition System and Behavioural Approach System

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do *not* leave any blank. Choose only *one* response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Choose from the following four response options:

1 = very true for me

2 = somewhat true for me

3 = somewhat false for me

4 = very false for me

Please circle your chosen response.

		Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
1	A person's family is the most important thing in life	1	2	3	4
2	Even if something bad is about to happen to me, I rarely experience fear or nervousness	1	2	3	4
3	I go out of my way to get things I want	1	2	3	4
4	When I'm doing well at something I love to keep at it	1	2	3	4
5	I'm always willing to try something new if I think it will be fun	1	2	3	4
6	How I dress is important to me	1	2	3	4
7	When I get something I want, I feel excited and energized	1	2	3	4
8	Criticism or scolding hurts me quite a bit	1	2	3	4
9	When I want something I usually go all-out to get it	1	2	3	4
10	I will often do things for no other reason than that they might be fun	1	2	3	4
11	It's hard for me to find the time to do things such as get a haircut	1	2	3	4
12	If I see a chance to get something I want I move on it right away	1	2	3	4
13	I feel pretty worried or upset when I think or know somebody is angry at me	1	2	3	4
14	When I see an opportunity for something I like I get excited right away	1	2	3	4

15	I often act on the spur of the moment	1	2	3	4
16	If I think something unpleasant is going to happen I usually get pretty “worked up”	1	2	3	4
17	I often wonder why people act the way they do	1	2	3	4
18	When good things happen to me, it affects me strongly	1	2	3	4
19	I feel worried when I think I have done poorly at something important	1	2	3	4
20	I crave excitement and new sensations	1	2	3	4
21	When I go after something I use a “no holds barred” approach	1	2	3	4
22	I have very few fears compared to my friends	1	2	3	4
23	It would excite me to win a contest	1	2	3	4
24	I worry about making mistakes	1	2	3	4

A6. Childhood Experience of Care and Neglect Questionnaire

FAMILY RELATIONSHIPS IN CHILDHOOD

CECA-Q2

This questionnaire concerns aspects of childhood. We are equally interested in people with TYPICAL OR ATYPICAL experience.

We would be very grateful if you could fill in all of the following questions about yourself.

WHO BROUGHT YOU UP BEFORE AGE 17

List the the **PARENT FIGURES** who brought you up in childhood for at least a year or longer. Circle any of those that apply:

Mother figure(s)	Father figure(s)
0. Natural/birth mother	1. Natural/birth father
1. Stepmother	2. Stepfather
2. Female relative……	3. Male Relative
3. Family friend (incl godparent)	4. Family friend
4. Foster mother	5. Foster father
5. Adoptive mother	6. Adoptive father
6. Other……	7. Other……

Were you ever in a children's home or institution prior to age 17? YES/NO

(Please circle) If yes:

What was the total length of time in the children's home?_____years

LOSS OF PARENT BEFORE AGE 17	**MOTHER**	**FATHER**
Did either parent die before you were age 17?	**YES/ NO**	**YES/ NO**
IF YES: What age were you?	**AGE.....**	**AGE.....**
Have you ever been separated from your parent for one year or more before age 17?	**YES/ NO**	**YES/ NO**
IF SEPARATED:	**MOTHER**	**FATHER**
At what age were you first separated?	**AGE.....**	**AGE**.....
How long was this separation?	**.....**	**.....**
	YEARS	**YEARS**
What was the reason for separation? (please circle)	1. Illness 2. Work 3. Divorce/ separation 4. Never knew parent 5. Abandoned 6.Other reason	1. Illness 2. Work 3. Divorce/ separation 4. Never knew parent 5. Abandoned 6.Other reason

Please describe your experience.....

3. AS YOU REMEMBER YOUR MOTHER FIGURE IN YOUR FIRST 17 YEARS:

Please circle the appropriate number. If you more than one mother figure, choose the one you were with longest, or the one you found most difficult to live with.

WHICH MOTHER FIGURE ARE YOU DESCRIBING BELOW?

1. Natural mother
2. Step-mother/father's live-in partner
3. Other relative e.g. aunty, grandmother
4. Other non-relative e.g. foster mother, godmother
5. Other (describe).....

		YES				NO
		DEFINITELY		UNSURE		NOT AT ALL
1.	She was very difficult to please.....	5	4	3	2	1
2.	She was concerned about my worries.....	5	4	3	2	1
3.	She was interested in how I did at school.	5	4	3	2	1
4.	She made me feel unwanted.....	5	4	3	2	1
5.	She tried to make me feel better when I was upset.....	5	4	3	2	1
6.	She was very critical of me.....	5	4	3	2	1
7.	She would leave me unsupervised before I was 10 years old.....	5	4	3	2	1
8.	She would usually have time to talk to me	5	4	3	2	1
9.	At times she made me feel I was a nuisance	5	4	3	2	1
10.	She often picked on me unfairly.....	5	4	3	2	1
11.	She was there if I needed her.....	5	4	3	2	1
12.	She was interested in who my friends were	5	4	3	2	1
13.	She was concerned about my whereabouts..	5	4	3	2	1

14.	She cared for me when I was ill.....	5	4	3	2	1
15.	She neglected my basic needs (e.g. food and clothes)	5	4	3	2	1
16.	She did not like me as much as my brothers and sisters..... (Leave blank if no siblings)	5	4	3	2	1

Do you want to add anything about your mother?.....

The following items describe some behaviours that can occur from parents.

Did your mother/mother figure ever act like this towards you?

(Please circle the appropriate response)

					HOW FREQUENT ?			
1	She would tease me	Yes	Unsure	No	Never	Once	Rarely	Often
2	She made me keep secrets	Yes	Unsure	No	Never	Once	Rarely	Often
3	She undermined my confidence	Yes	Unsure	No	Never	Once	Rarely	Often
4	She would confuse me by telling me to do contradictory things	Yes	Unsure	No	Never	Once	Rarely	Often
5	She played on my fears	Yes	Unsure	No	Never	Once	Rarely	Often
6	She liked to see me suffer	Yes	Unsure	No	Never	Once	Rarely	Often
7.	She humiliated me, put me down	Yes	Unsure	No	Never	Once	Rarely	Often
8.	She would shame me in front of others.	Yes	Unsure	No	Never	Once	Rarely	Often
9	She was very rejecting	Yes	Unsure	No	Never	Once	Rarely	Often
10	She took away the things I cherished	Yes	Unsure	No	Never	Once	Rarely	Often

11	She would make me eat things I didn't like until I was sick…	Yes	Unsure	No	Never	Once	Rarely	Often
12.	She would deliberately deprive me of light, food or company	Yes	Unsure	No	Never	Once	Rarely	Often
13	She would not let me mix with people I wanted to see	Yes	Unsure	No	Never	Once	Rarely	Often
14	She would would make me feel guilty so I would do what I was told	Yes	Unsure	No	Never	Once	Rarely	Often
15.	She threatened to hurt the people dear to me to get what she wanted	Yes	Unsure	No	Never	Once	Rarely	Often
16	She forced me to steal or break the law for her	Yes	Unsure	No	Never	Once	Rarely	Often
17	She said she wanted me dead	Yes	Unsure	No	Never	Once	Rarely	Often

If any of these occurred at what age were you when it started?_____ years old

4. **AS YOU REMEMBER YOUR FATHER FIGURE IN YOUR FIRST 17 YEARS**

Please circle the appropriate number. If you had more than one father figure, choose the one you were with longest, or the one you found the most difficult to live with. If you had no father in the household then leave out this section.

WHICH FATHER FIGURE ARE YOU DESCRIBING BELOW?

1. Natural father
2. Step-father/ mother's live-in partner
3. Other relative e.g. uncle, grandfather
4. Other non-relative e.g. foster father, adoptive father
5. Other (describe).....

		YES			NO	
		DEFINITELY		UNSURE	NOT AT ALL	
1.	He was very difficult to please.....	5	4	3	2	1
2.	He was concerned about my worries.....	5	4	3	2	1
3.	He was interested in how I did at school..	5	4	3	2	1
4.	He made me feel unwanted.....	5	4	3	2	1
5.	He tried to make me feel better when I was upset.....	5	4	3	2	1
6.	He was very critical of me.....	5	4	3	2	1
7.	He would leave me unsupervised before I was 10 years old.....	5	4	3	2	1
8.	He would usually have time to talk to me	5	4	3	2	1
9.	At times he made me feel I was a nuisance	5	4	3	2	1
10.	He often picked on me unfairly.....	5	4	3	2	1
11.	He was there if I needed him.....	5	4	3	2	1
12.	He was interested in who my friends were	5	4	3	2	1

13.	He was concerned about my whereabouts..	5	4	3	2	1
14.	He cared for me when I was ill.....	5	4	3	2	1
15.	He neglected my basic needs (e.g. food and clothes)	5	4	3	2	1
16.	He did not like me as much as my brothers and sisters..... (Leave blank if no siblings)	5	4	3	2	1

Do you want to add anything about your father?.....

The following items describe some behaviours that can occur from parents.

Did your father/father figure ever act like this towards you ?

(Please circle the appropriate descriptor)

					HOW FREQUENT ?			
1	He would tease me	Yes	Unsure	No	Never	Once	Rarely	Often
2	He made me keep secrets	Yes	Unsure	No	Never	Once	Rarely	Often
3	He undermined my confidence	Yes	Unsure	No	Never	Once	Rarely	Often
4	He would confuse me by telling me to do contradictory things	Yes	Unsure	No	Never	Once	Rarely	Often
5	He played on my fears	Yes	Unsure	No	Never	Once	Rarely	Often
6	He liked to see me suffer	Yes	Unsure	No	Never	Once	Rarely	Often
7.	He humiliated me, put me down	Yes	Unsure	No	Never	Once	Rarely	Often
8.	He would shame me in front of others.	Yes	Unsure	No	Never	Once	Rarely	Often
9	He was very rejecting	Yes	Unsure	No	Never	Once	Rarely	Often
10	He took away the things I cherished	Yes	Unsure	No	Never	Once	Rarely	Often

11	He would make me eat things I didn't like until I was sick…	Yes	Unsure	No	Never	Once	Rarely	Often
12.	He would stop me having light, food or company	Yes	Unsure	No	Never	Once	Rarely	Often
13	He would not let me mix with people I wanted to see	Yes	Unsure	No	Never	Once	Rarely	Often
14	He would would make me feel guilty so I would do what I was told	Yes	Unsure	No	Never	Once	Rarely	Often
15.	He threatened to hurt the people dear to me to get what he wanted	Yes	Unsure	No	Never	Once	Rarely	Often
16	He forced me to steal or break the law for her	Yes	Unsure	No	Never	Once	Rarely	Often
17	He said he wanted me dead	Yes	Unsure	No	Never	Once	Rarely	Often

If any of these occurred at what age were you when it started?_____ years old

5. **CLOSE RELATIONSHIPS IN CHILDHOOD**

(Please circle as appropriate)

When you were a child or teenager, were there any **ADULTS** you could go to with your problems or to discuss your feelings? **YES/ NO**

IF YES: Who was that?

(Circle more than one if relevant)

1. Mother/ mother figure
2. Father/ father figure
3. Other relative
4. Family friend
5. Teacher, vicar, etc
6. Other (describe).....

Do you want to note anything about the relationship(s)?.....

Were there other **CHILDREN/TEENAGERS** your age that you could discuss your problems and feelings with? **YES/NO**

IF YES: Who was that?

(Circle more than one if relevant)

1. Sister
2. Brother
3. Other relative

4. Close friend

5. Other less close friend(s)

6. Other person (describe).....

Do you want to note anything about the relationship(s)?.....

Who would you describe as the **TWO CLOSEST** people to you as a child/teenager? (Circle up to two)

1. Mother/ mother figure

2. Father/ father figure

3. Sister or brother

4. Other relative

5. Family friend (adult)

6. Friend your age

7. Other (describe).....

Do you want to note anything about the relationship(s)?.....

6. **PHYSICAL PUNISHMENT BEFORE AGE 17 BY PARENT FIGURE OR OTHER HOUSEHOLD MEMBER**

When you were a child or teenager were you ever hit repeatedly with an implement (such as a belt or stick) or punched, kicked or burnt by someone in the household? **YES/ NO**

IF NO THEN SKIP TO 7 OVERLEAF:

IF 'YES'	**MOTHER FIGURE**	**FATHER FIGURE**
How old were you when it began?	**AGE**.....	**AGE**.....
Did the hitting happen on more than one occasion?	**YES/ NO**	**YES/ NO**
How were you hit?	**1.Belt or stick** **2.Punched/kicked** **3.Hit with hand** **4.Other**	**1.Belt or stick** **2.Punched/kicked** **3.Hit with hand** **4.Other**
Were you ever injured e.g. bruises, black eyes, broken limbs?	**YES/ NO**	**YES/ NO**
Was this person so angry they seemed out of control?	**YES/ NO**	**YES/ NO**

Can you describe these experiences?

.....

.....

Did you experience this from anyone else in the household? **YES/ NO**

IF YES: DESCRIBE BELOW

.....

7. **UNWANTED SEXUAL EXPERIENCES BEFORE AGE 17**

(Please circle as appropriate)

When you were a child or teenager did you ever have any unwanted sexual experiences? **YES/ NO/ UNSURE**

Did anyone force you or persuade you have sexual intercourse against your wishes before age 17? **YES/ NO/ UNSURE**

Can you think of any upsetting sexual experiences before age 17 with a related adult or someone in authority e.g.teacher? **YES/ NO/ UNSURE**

IF NONE THEN SKIP TO 8 OVERLEAF.

IF 'YES' OR 'UNSURE' TO ABOVE THEN COMPLETE THE FOLLOWING:

	FIRST EXPERIENCE	**OTHER EXPERIENCE**
How old were you when it began?	**AGE** **.....**	**AGE** **.....**
Was the other person someone you knew?	**YES/ NO**	**YES/ NO**
Was the other person a relative?	**YES/ NO**	**YES/ NO**
Did the other person live in your household?	**YES/ NO**	**YES/ NO**
Did this person do it to you on more than one occasion?	**YES/ NO**	**YES/ NO**
Did it involve touching private parts of your body?	**YES/ NO**	**YES/ NO**
Did it involve touching private parts of the other persons body?	**YES/ NO**	**YES/ N**O
Did it involve sexual intercourse?	**YES/ NO**	**YES/ NO**

Can you describe these experiences?

.....

Thank you for your help with this questionnaire. We realise that it is difficult to give a true picture of your true childhood experience in a questionnaire, so if you have any comments you would like to add, please write them below.

Your response will be treated in the strictest confidence.

A7. Film Task Ratings

This scale consists of a number of words that describe different feelings and emotions. Please rate how strongly they felt each of the following emotions using the scale below. Read each item and then write the appropriate number next to the word.

How they feel

0	1	2	3	4
Very slightly or not at all	A little	Moderately	Quite a Bit	Extremely

Emotions	Film 1	Film 2	Film 3	Film 4	Film 5
Happy					
Sad					
Irritated					
Angry					
Amused					
Worried					
Frustrated					
Neutral					
Annoyed					
Nervous					
Pleased					
Disgusted					
Sympathetic					
Interested					
Anxious					
Concerned					
Empathetic					
Other Emotion					

Film Task Ratings

This scale consists of a number of words that describe different feelings and emotions. Indicate to what extent you experienced each emotion whilst watching the film. Read each item and then write the appropriate number next to the word.

How I feel

0	1	2	3	4
Very slightly or not at all	A little	Moderately	Quite a Bit	Extremely

Emotions	Film 1	Film 2	Film 3	Film 4	Film 5
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					
Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
Afraid					
Amused					
Sad					

A8. Eating Disorder Diagnostic Screen

KING'S College LONDON
University of London

Nutrition, Eating and Stress in Pregnancy (NEST-p)
EATING SCREEN

We are studying the effect of stress and eating during your pregnancy and we would be grateful if you could fill in this questionnaire. Please be aware that this is voluntary and will not affect your medical care or legal rights.

	Not at all		Slightly		Moderately		Extremely
1. Have you **ever** felt fat?	0	1	2	3	4	5	6
2. Have you **ever** had a definite fear that you might gain weight or become fat?	0	1	2	3	4	5	6
What about within the **last 3 months**?	0	1	2	3	4	5	6
What about within the **last 6 months**?	0	1	2	3	4	5	6
3. Has your weight **ever** influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
What about within the **last 3 months**?	0	1	2	3	4	5	6
What about within the **last 6 months**?	0	1	2	3	4	5	6
4. Has your shape ever influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
What about within the **last 3 months**?	0	1	2	3	4	5	6
What about within the **last 6 months**?	0	1	2	3	4	5	6

5. **Have there ever** been times when you felt you have eaten what other people would regard as an unusually large amount of food (e.g., a tub of ice cream) given the circumstances? **YES NO**

   What about within the **last 3 months**? **YES NO**

   What about within the **last 6 months**? **YES NO**

6. **During the times when you ate an unusually large amount of food**, did you experience a loss of control (or feel you couldn't stop eating or control what how much you were eating)? **YES NO**

   What about within the **last 3 months**? **YES NO**

   What about within the **last 6 months**? **YES NO**

If you have answered yes to both question 5 AND 6 please answer questions 7-14 (If no go to Q15) →

During these episodes of overeating and loss of control…

7. How many **DAYS per week** on average did you eat an unusually large amount of food and experience a loss of control? **0 1 2 3 4 5 6 7**

8. How many **TIMES per week** on average did you eat an unusually large amount of food and experience a loss of control? **0 1 2 3 4 5 6 7 8 9 10 11 12 13 14**

9. Did you eat much more rapidly than normal? **YES NO**
10. Did you eat until you felt uncomfortably full? **YES NO**
11. Did you eat large amounts of food when you didn't feel physically hungry? **YES NO**
12. Did you eat alone because you were embarrassed by how much you were eating? **YES NO**
13. Feel disgusted with yourself, depressed, or very guilty after overeating? **YES NO**
14. Feel very upset about your uncontrollable overeating or resulting weight gain? **YES NO**

15a. Have you ever made yourself vomit to prevent weight gain or counteract the effects of eating? **YES NO**

15b. **If yes…When? LAST 3 MONTHS** ☐ **LAST 6 MONTHS** ☐ **MORE THAN A YEAR AGO** ☐

15c. How many **times per week** on average did you make yourself vomit to prevent weight gain or counteract the effects effects of eating?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

16a. Have you ever used laxatives or diuretics to prevent weight gain or counteract the effects of eating? **YES NO**

16b. **If yes…When? LAST 3 MONTHS** ☐ **LAST 6 MONTHS** ☐ **MORE THAN A YEAR AGO** ☐

16c. How many **times per week** on average have you used laxatives or diuretics to prevent weight gain or counteract the effects of eating?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

17a. Have you ever fasted (skipped at least 2 meals in a row) to prevent weight gain or counteract the effect of eating? **YES NO**

17b. **If yes…When? LAST 3 MONTHS** ☐ **LAST 6 MONTHS** ☐ **MORE THAN A YEAR AGO** ☐

17c. How many **times per week** on average did you fast (skip at least 2 meals in a row) to prevent weight gain or counteract the effects of eating?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

18a. Have you ever engaged in excessive exercise specifically to counteract the effects of overeating episodes? **YES NO**

18b. **If yes…When? LAST 3 MONTHS** ☐ **LAST 6 MONTHS** ☐ **MORE THAN A YEAR AGO** ☐

18c. How many **times per week** on average have you engaged in excessive exercise specifically to counteract the effects of overeating episodes?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

---

19. How much do you weigh? If uncertain, please give your best estimate. **stones lbs /.... kg**

20. How tall are you? **ft in / cm**

21. What is your age? .....

22. How many weeks pregnant are you?.....

23. When was the last day of your last menstrual period prior to becoming pregnant?

24. Were you taking the contraceptive pill/breastfeeding in the 6 months to becoming pregnant? **YES NO**

If no, did you miss any periods in the last 6 months before becoming pregnant? **YES NO**

If yes, how many? .....

25. Was your pregnancy planned? **YES NO**

Thank you for completing this questionnaire. We would like to contact you again to give you information about the study, and to give you the opportunity to take part. If you are happy for us to do so please fill in the box below.

Name ……Telephone……
Email……..Signature……Date……
(Please print carefully)

A9. Demographic questionnaire

1. General

1. Date of Birth 2. Age at inclusion	
3. Date of last menstrual period	
4. Gestation (Weeks) By LMP/By USS:	
5. Due Date	

2. Marital Status (tick)

1. Single (no partner)	
2. Single (with Partner)	
3. Cohabiting	
4. Married	

3. Ethnicity (tick)

1. British	White	
	Black	
	Asian	
	Chinese	
2. Black Caribbean		
3. Black Africa		
4. Asian	Indian	
	Pakistani	
	Bangladeshi	
5. Chinese		
Other	White	
	Black	
	Asian	
	Chinese	
Mixed		

4. Employment

1. Employed	Working
	On Maternity Leave
	On Sick Leave
2. Unemployed	
3. Full time mother	
Please specify what work was done: previously	
4. Student	
5. Other	

5. Type of Employment (provide details)

1. Professional	
2. Managerial and technical	
3. Skilled	Non-manual: Manual:
4. Partly skilled	
5. Unskilled	

6. Education

1. 1. no formal qualifications	
2. GCSE's/NVQS	
3. A Levels	
4. Higher Education	

7. Smoking

Previous smoker (give details)	
Current smoker:	1. None
	2. 1-9 cigarettes a day
	3. 10-19 cigarettes a day
	4. more than 20 cigarettes a day

8a. Are you currently taking any street drugs? Please provide details?

8b. what is your current alcohol intake?

9. Coffee/Tea (caffeinated)

Current: Yes/No	
Coffee (cups per day)	
Tea (cups per day – excluding herbal tea)	

10a. Pre-pregnancy weight and height:_____

10b. Current weight: _____

BMI (to be completed by researcher)	
1. Underweight (<19.8)	
2. Normal Weight (19.8-26)	
3. Overweight (>26.0-29.0)	
4. Obese (>29.0)	

11: Current medical Conditions

1. Yes/No	
2. Give Details	

12: Are you taking any current medication, vitamins or supplements (please give details)

13. Family psychiatric history in 1st degree relatives (Please give details)

Yes	
No	
Possible but not sure	
Not known	

A10. Beck Depression Inventory

Beck Depression Inventory

Choose one statement from among the group of four statements in each question that best describes how you have been feeling during the **past few days**. Circle the number beside your choice.

1	**0** I do not feel sad. **1** I feel sad. **2** I am sad all the time and I can't snap out of it. **3** I am so sad or unhappy that I can't stand it.	8	**0** I don't feel I am any worse than anybody else. **1** I am critical of myself for my weaknesses or mistakes. **2** I blame myself all the time for my faults. **3** I blame myself for everything bad that happens.
2	**0** I am not particularly discouraged about the future. **1** I feel discouraged about the future. **2** I feel I have nothing to look forward to. **3** I feel that the future is hopeless and that things cannot improve.	9	**0** I don't have any thoughts of killing myself. **1** I have thoughts of killing myself, but I would not carry them out. **2** I would like to kill myself. **3** I would kill myself if I had the chance.
3	**0** I do not feel like a failure. **1** I feel I have failed more than the average person. **2** As I look back on my life, all I can see is a lot of failure. **3** I feel I am a complete failure as a person.	10	**0** I don't cry any more than usual. **1** I cry more now than I used to. **2** I cry all the time now. **3** I used to be able to cry, but now I can't cry even though I want to.
4	**0** I get as much satisfaction out of things as I used to. **1** I don't enjoy things the way I used to. **2** I don't get any real satisfaction out of anything anymore. **3** I am dissatisfied or bored with everything.	11	**0** I am no more irritated by things than I ever am. **1** I am slightly more irritated now than usual. **2** I am quite annoyed or irritated a good deal of the time. **3** I feel irritated all the time now.
5	**0** I don't feel particularly guilty. **1** I feel guilty a good part of the time. **2** I feel quite guilty most of the time. **3** I feel guilty all of the time.	12	**0** I have not lost interest in other people. **1** I am less interested in other people than I used to be. **2** I have lost most of my interest in other people. **3** I have lost all of my interest in other people.
6	**0** I don't feel I am being punished. **1** I feel I may be punished. **2** I expect to be punished. **3** I feel I am being punished.	13	**0** I make decisions about as well as I ever could. **1** I put off making decisions more than I used to. **2** I have greater difficulty in making decisions than before. **3** I can't make decisions at all anymore.
7	**0** I don't feel disappointed in myself. **1** I am disappointed in myself. **2** I am disgusted with myself. **3** I hate myself.	14	**0** I don't feel that I look any worse than I used to. **1** I am worried that I am looking old or unattractive. **2** I feel that there are permanent changes in my appearance that make me look unattractive. **3** I believe that I look ugly.

15	**0** I can work about as well as before. **1** It takes an extra effort to get started at doing something. **2** I have to push myself very hard to do anything. **3** I can't do any work at all.	19	**0** I haven't lost much weight, if any, lately. **1** I have lost more than five pounds. **2** I have lost more than ten pounds. **3** I have lost more than fifteen pounds. (Score 0 if you have been purposely trying to lose weight.)
16	**0** I can sleep as well as usual. **1** I don't sleep as well as I used to. **2** I wake up 1-2 hours earlier than usual and find it hard to get back to sleep. **3** I wake up several hours earlier than I used to and cannot get back to sleep.	20	**0** I am no more worried about my health than usual. **1** I am worried about physical problems such as aches and pains, or upset stomach, or constipation. **2** I am very worried about physical problems, and it's hard to think of much else. **3** I am so worried about my physical problems that I cannot think about anything else.
17	**0** I don't get more tired than usual. **1** I get tired more easily than I used to. **2** I get tired from doing almost anything. **3** I am too tired to do anything.	21	**0** I have not noticed any recent change in my interest in sex. **1** I am less interested in sex than I used to be. **2** I am much less interested in sex now. **3** I have lost interested in sex completely.
18	**0** My appetite is no worse than usual. **1** My appetite is not as good as it used to be. **2** My appetite is much worse now. **3** I have no appetite at all anymore.		

A11. State-Trait Anxiety Inventory

SELF- EVALUATION QUESTIONNAIRE 1

A number of statements which people have used to describe themselves are given below. Read each statement and then **tick** in the appropriate box on the right to indicate how you feel **right now**, that is, **at this moment.** There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your **present feelings** best.

	Not At All	**Somewhat**	**Moderately**	**Very much**
1. I feel calm				
2. I feel secure				
3. I feel tense				
4. I feel strained				
5. I feel at ease				
6. I feel upset				
7. I am presently worrying over possible misfortunes				
8. I feel satisfied				
9. I feel frightened				
10. I feel comfortable				
11. I feel self-confident				
12. I feel nervous				
13. I am jittery				
14 I feel indecisive				
15. I am relaxed				
16. I feel content				
17. I am worried				
18. I feel confused				
19. I feel steady				
20. I feel pleasant				

SELF- EVALUATION QUESTIONNAIRE 2

A number of statements which people have used to describe themselves are given below. Read each statement and then **tick** in the appropriate box on the right to indicate how you **generally feel**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how *you* ***generally feel.***

		Almost Never	Sometimes	Often	Almost Always
1.	I feel pleasant.				
2.	I feel nervous and restless.				
3.	I feel satisfied with myself.				
4.	I wish I could be as happy as others seem to be.				
5.	I feel like a failure.				
6.	I feel rested.				
7.	I am “calm, cool, and collected.”				
8.	I feel that difficulties are piling up so that I cannot overcome them.				
9.	I worry too much about something that really does not matter.				
10.	I am happy.				
11.	I have disturbing thoughts.				
12.	I lack self-confidence.				
13.	I feel secure.				
14.	I make decisions easily.				
15.	I feel inadequate.				
16.	I am content.				
17.	Some unimportant thought runs through my mind and bothers me.				
18.	I take disappointments so keenly that I cannot put them out of my mind.				
19.	I am a steady person.				
20.	I get in a state of tension or turmoil as I think over my recent concerns and interests.				

A12. Neonatal Behavioural Assessment Scale

NBAS SCORING FORM

Baby Name.....**Date of Assessment**..... **Examiner**.....

Sex..... dob..... Gestational age..... Birthweight..... ..Height.....HC..... Mode of delivery.....

Length of Labour.....Apgar scores..... ...Parity..... ..Type of feeding.....

Infant Behaviour

Habituation	9	8	7	6	5	4	3	2	1	**Comments**
Response dec. to light										
Response dec. to rattle										
Response dec. to bell										
Res. dec. to foot probe										

Social-Interactive	9	8	7	6	5	4	3	2	1	**Comments**
Animate visual										
Animate visual & auditory										
Inanimate visual										
Inanimate visual & auditory										
Inanimate auditory										
Animate auditory										
Alertness										

Motor System	9	8	7	6	5	4	3	2	1	**Comments**
General tone										
Motor maturity										
Pull- to-sit										
Defensive										
Activity level										

State Organisation	9	8	7	6	5	4	3	2	1	**Comments**
Peak of excitement										
Rapidity of build- up										
Irritability										
Lability of states										

State Regulation	9	8	7	6	5	4	3	2	1	**Comments**
Cuddliness										
Consolability										
Self-quieting										
Hand-to-mouth										

Autonomic System	9	8	7	6	5	4	3	2	1	**Comments**
Tremulousness										
Startles										
Lability of skin colour										

Smiles ☐

Supplementary Items	9	8	7	6	5	4	3	2	1	Comments
Quality of alertness										
Cost of attention										
Examiner facilitation										
General irritability										
Robustness & endurance										
State regulation										
E's emotional response										

Reflexes	0	1	2	3	Asym	Comments
Plantar						
Babinski						
Ankle clonus						
Rooting						
Sucking						
Glabella						
Passive resist - legs						
Passive resist - arms						
Palmar (hand grasp)						
Placing						
Standing						
Walking						
Crawling						
Incurvation						
Tonic dev. – head & eyes						
Nystagmus						
TNR						
Moro						

SUMMARY : INFANT	
Strengths	Concerns

SUMMARY : PARENT(S)	
Strengths	Concerns

RECOMMENDATIONS FOR CAREGIVING:-

A13. Maternal-to-Infant Bonding Scale

These questions are about your feelings for your child in the first few weeks. Some adjectives are listed below which describe some of the feelings mothers have towards their baby in the FIRST WEEKS after they were born. Please make a tick against each word in the box which, best describes how you felt in the FIRST FEW WEEKS.

Date of birth of baby: Date form filled in:

	Very Much	A Lot	A Little	Not at All
Loving				
Resentful				
Neutral or felt nothing				
Joyful				
Dislike				
Protective				
Disappointed				
Aggressive				

A14. Ethical Approval Forms

NHS
Health Research Authority
NRES Committee London - Central

Skipton House

80 London Road London SE1 6LH

Telephone:
020 797
22560

21 December 2012 re-issued 13th February 2013

Miss Freya Corfield
PhD Student
King's College London, Institute of Psychiatry
P059
De Crespigny Park, London
SE5 8AF

Dear Miss Corfield

Study title:	**Understanding the social dynamics of relationships: Social cognition in eating disorders**
REC reference:	**12/LO/1870**
IRAS project ID:	**110068**

Thank you for your letter of 11 December 2012, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission to publish, please contact the Co-ordinator Julie Kidd, NRESCommittee.London-Central@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see

"Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the
start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research
Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Advertisement	1.2	11 December 2012
Covering Letter		07 November 2012
Evidence of insurance or indemnity		30 July 2012
Investigator CV		07 November 2012
Other: Email from J Liebscher R&D	1.1	07 November 2012
Other: Letter from Gallagher Heath (Insurance Brokers)		01 August 2012
Other: Letter from Zurich Municipal		20 July 2012
Other: Supervisors CV Janet Treasure	1.1	07 November 2012
Other: Recruitment E-Mail	1.2	11 December 2012
Other: Attentional Bias, Emotion Recognition, and Emotion Regulation in Anorexia: State or Trial Article		
Other: Sample Size Calculations by Dr. Masashi Suda		
Other: Statistics		
Participant Consent Form	1.2	11 December 2012
Participant Information Sheet	1.2	11 December 2012

Protocol	1.1	07 November 2012
Questionnaire: CSIE	1.1	07 November 2012
Questionnaire: VASQ	1.1	07 November 2012
Questionnaire: BIS/BAS	1.1	07 November 2012
Questionnaire: Demographic Questionnaire	1.1	07 November 2012
Questionnaire: DASS21	1.1	07 November 2012
Rating Interpersonal Scenarios: Videos	1.1	07 November 2012
EDE-Q	1.1	07 November 2012
REC application		07 November 2012
Referees or other scientific critique report	1.1	07 November 2012
Response to Request for Further Information		11 December 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

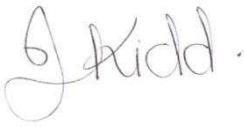
Further information is available at National Research Ethics Service website > After Review

12/LO/1870 **Please quote this number on all correspondence**

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

With the Committee's best wishes for the success of this project.

Yours sincerely pp



Dr John Keen
Chair

Email:NRESCommittee.London-Central@nhs.net

Enclosures: "After ethical review – guidance for researchers"

Copy to: *Miss Jennifer Liebscher, King's College London, Institute of Psychaitry*

Research Ethics Office

5.11 Franklin-Wilkins Building
(Waterloo Bridge Wing)
Stamford Street
London SE1 9NH
Tel 020 7848 4077/4070/4020
Email rec@kcl.ac.uk
www.kcl.ac.uk/research/ethics

KING'S College LONDON

Freya Corfield
Eating Disorders Unit
Department of Academic Psychiatry
5th Floor
Bermondsey Wing Guy's Hospital
Great Maze Pond
London SE1 9RT

08 June 2011

Dear Freya

PNM/10/11-111 A Pilot Study: Investigating Attentional Bias towards Infant Faces in Eating Disorders

Thank you for sending in the amendments requested to the above project. I am pleased to inform you that these meet the requirements of the PNM RESC and therefore that full approval is now granted.

Please ensure that you follow all relevant guidance as laid out in the King's College London Guidelines on Good Practice in Academic Research (http://www.kcl.ac.uk/college/policyzone/index.php?id=247).

For your information ethical approval is granted until **08 June 2013**. If you need approval beyond this point you will need to apply for an extension to approval at least two weeks prior to this explaining why the extension is needed, (please note however that a full re-application will not be necessary unless the protocol has changed). You should also note that if your approval is for one year, you will not be sent a reminder when it is due to lapse.

If you do not start the project within three months of this letter please contact the Research Ethics Office. Should you need to modify the project or request an extension to approval you will need approval for this and should follow the guidance relating to modifying approved applications: http://www.kcl.ac.uk/research/ethics/applicants/modifications.html

Any unforeseen ethical problems arising during the course of the project should be reported to the approving committee/panel. In the event of an untoward event or an adverse reaction a full report must be made to the Chairman of the approving committee/review panel within one week of the incident.

Please would you also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

If you have any query about any aspect of this ethical approval, please contact your panel/committee administrator in the first instance (http://www.kcl.ac.uk/research/ethics/contacts.html). We wish you every success with this work.

With best wishes

Yours sincerely

Jim Summers
Research Ethics Team Leader

c.c. Professor Janet Treasure

Health Research Authority

NRES Committee London - Camberwell St Giles

Bristol Research Ethics Centre Level 3, Block B Whitefriars Lewins Mead Bristol
BS1 2NT

Tel: 01173421334
Fax: 01173420445

23 April 2013

Dr Nadia Micali
Locum Consultant Psychiatrist and Clinical Research Worker
Institute of Psychiatry
Institute of Psychiatry, Box PO85
De Crespigny Park
London, UK SE5 8AF

Dear Dr Micali

Study title:	**Nutrition Eating and STress in Pregnancy (NEST-p): a study of risk mechanisms**
REC reference:	**09/H0807/12**
Amendment number:	**2**
Amendment date:	**09 April 2013**
IRAS project ID:	**14793**

Thank you for your letter of 09 April 2013, notifying the Committee of the above amendment.

The Committee does not consider this to be a “substantial amendment“ as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	Version	Date
Notification of a Minor Amendment	2	09 April 2013

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for

Research Ethics Committees in the UK.

09/H0807/12: **Please quote this number on all correspondence**

Yours sincerely

Miss Christine Hobson
Committee Co-ordinator

E-mail: nrescommittee.southwest-frenchay@nhs.net

Copy to: *Ms Adriana Fanigliulo, SLaM/IoP R&D Office*
Mrs Gill Lambert